Staffordshire University

Business School

BANK EFFICIENCY, EUROIZATION AND MACROPRUDENTIAL POLICY IN TRANSITION ECONOMIES- WITH SPECIAL REFERENCE TO SOUTH EAST EUROPEAN COUNTRIES

ALBULENA XHELILI

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ABSTRACT

The literature on bank efficiency in transition economies (TEs) is neither exhaustive nor conclusive. It mainly investigates bank efficiency in relation to bank size and ownership. However, to the best of our knowledge, it ignores several important dimensions related to the banking sector in TEs: euroization, macroprudential policy and different types of risk. By exploring the relationships between bank efficiency, euroization, macroprudential policy and different types of risk in TEs, this research fills this gap.

The relationship between bank efficiency, euroization and bank risk is explored empirically through the estimation of a cost efficiency frontier using time-varying stochastic frontier analysis (SFA) whilst controlling initially for euroization at country level and then at bank level, using the BankScope database and euroization data collected by the author. The findings suggest that euroization at country level is a driver of bank efficiency in TEs, and that different risks are important in the context bank efficiency in TEs. Furthermore, it was shown that efficiency in TEs has varied over period and it has been affected by the Global Financial Crisis.

The initial research is extended through the qualitative analysis of the phenomena of euroization at bank level in selected South East European countries, which again to the best of our knowledge, is the first such research. The investigation is conducted through semi-structured interviews of risk managers of banks at different levels of seniority. The main finding of this analysis is that macroprudential policy, widely considered a useful response to global financial crisis, is an important determinant of euroization.

To explore this further an econometric investigation of the impact of macroprudential policy on the level of credit euroization in TEs, an aspect ignored in the literature, is undertaken. Additionally, the empirical literature on credit euroization is limited as most studies focus on deposit euroization, assuming that credit euroization mirrors it, although the latter is larger in most TEs. The analysis is conducted employing dynamic and autoregressive panel techniques, using data on macroprudential policy from the IMF and central banks. Thus, this study fills a gap in this literature by investigating the determinants of credit euroization, including the impact of macroprudential policy. Although this is a first attempt at such an investigation, it supports the importance of these policies in driving down the level of euroization in TEs.

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ABBREVIATIONS

AE- Allocative Efficiency

AR- Autoregressive

BC- Battesse and Coelli

BIS- Bank for International Settlements

CE- Credit Euroization

CEE- Central and Eastern Europe

CESEE- Central, Eastern and South-Eastern Europe

CFRs- Common Factor Restrictions

CIS- Commonwealth of Independent States

CR- Credit risk

DC- Domestic Currency

DEA- Data Envelopment Analysis

DFA- Distribution Free Approach

DM-Detche-Mark

DTI- Debt to Income Ratio

EBRD – European Bank for Reconstruction and Development

EDF- Expected Default Frequency

EE- Economic Efficiency

ERR- Exchange Rate

EU – European Union

FC- Foreign Currency

FD- Financial Deepening

FE – Financial Euroization

FEs –Fixed Effects

FO- Foreign Ownership

FSAP- Financial Sector Assessment Program

FSB- Financial Stability Board

FX- Foreign Exchange

GAAP- Generally Accepted Accounting Principles

GDP – Gross Domestic Product

GFC- Global Financial Crisis

GLS- Generalized Least Squares

GMM – Generalised Method of Moments

IFRS- International Financial Reporting Standards

IMF- International Monetary Fund

LTV- Loan to Value Ratio

ML- Maximum Likelihood

MLDV Maximum Likelihood Dummy Variables

MLE- Maximum Likelihood Estimation

MP- Macroprudential Policy

MPIs- Macroprudential Policy Instruments

MR-Market Risk

MVP- Minimum Variance Portfolio

NIM- Net Interest Margin

OLS – Ordinary Least Squares

OR - Operational Risk

REs – Random Effects

ROA- Return on Assets

RWA- Risk Weighted Assets

SEE – South-Eastern Europe

SFA- Stochastic Frontier analysis

SFM- Stochastic Frontier Methods

TE- Technical Efficiency

TEs- Transition Economies

TFA- Thick Frontier Approach

TRE- True Random Effects

WB-World Bank

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« *I dedicate this dissertation to my mom and dad* »

Chapter 1

Introduction

1.1 Introduction

The aim of this introductory chapter is to present the key research questions, provide an overview of the phenomena of euroization, bank efficiency and macroprudential policy, as well as consider their economic importance for transition economies (TEs). Initially, the chapter highlights the importance of the concepts of euroization and efficiency and their relevance in the process of transition to a market economy. It then continues with an elaboration of the specific objectives of the thesis, upon which the key research questions are based. Subsequently, it provides an overview of the recent history in TEs of the three main pillars of the thesis as a necessary background for the development of the formal models employed throughout the thesis and against which the results can be assessed. Specifically, it examines the evolution of the phenomenon of euroization throughout the period, describes the development of the banking sector in the first two decades of the process of transition from a centrally planned to the market based economy and finishes with a summary of the recently adopted macroprudential policy in these countries. The last section provides an explanation of the structure of the thesis focussing on the content and role of the following chapters.

1.2 The key research questions

The aim of the thesis is to investigate the relationships between bank efficiency, euroization and macroprudential policy in transition economies, with special reference to South East European countries. In the context of this thesis, and following the classification by the International Monetary Fund (IMF) which is based on each country's progress in transition (liberalization, macroeconomic stabilization, restructuring and privatization and legal and institutional reforms), the TEs are:

- South East European (SEE) countries: Albania, Bosnia and Herzegovina (B & H), Bulgaria, Croatia, Kosovo, Macedonia, Montenegro, Romania and Serbia;
- Central East European (CEE) countries: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic and Slovenia;
- Commonwealth of Independent States (CIS): Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

Particular attention is paid to the identification of the risks associated with euroization at both country and bank level. The thesis contributes to the existing theoretical and empirical literature on euroization and bank efficiency by addressing the relationships between bank efficiency, euroization and macroprudential policy.

The role of an efficient banking sector in economic development has been recognized in the literature since Schumpeter, when he argued that the banking sector can be an accelerator of growth (King and Levine, 1993a). However, a strong consensus regarding its positive role on economic growth, has been reached only in the last decade (Bonin and Wachtel, 2003; Borovicka, 2007). The foundation of the banking sector's significance lies in the role of banks as financial intermediaries. Banks provide liquidity services (Santos, 2000) and thus provide insurance against liquidity risk, enabling greater investment in high-return but illiquid assets (Levine, 1997), consequently contributing to accelerated economic growth (Bencivenga and Smith, 1991). They are considered delegated monitors since they reduce the cost of acquiring information and lower post monitoring costs (Bryant, 1980; Diamond, 1984) thus encouraging investment, which again can lead to faster economic growth. Additionally, banks are providers of risk diversification, which enables an appropriate degree of high return investments and can accelerate technological

change, which in the long run affects economic growth positively (King and Levine, 1993b; 1993c; Levine, 1997). Consequently, an efficient banking sector facilitates financial intermediation and contributes to economic growth. Thus, efficient banks create an efficient banking sector, which in turn translates into efficient intermediation process. Arguably efficiency of the banking sector is a precondition and a facilitator for the economic development of these economies (Wachtel, 2001; Beck et al., 2001; Bonin and Wachtel, 2003; Borovicka, 2007).

In economies such as TEs, where money and capital markets are underdeveloped (Grigorian and Manole, 2006; Yildirim and Philipatos, 2007) the role of banks and the banking sector is even more important than in mature market economies. In these economies, banks dominate financial intermediation, play an important role in the process of relocating financial resources (Anderson and Kegels, 1998) and bank credit is the major source of external finance (Caviglia et al., 2002). Arguably, efficiency of the banking sector is a precondition for the economic development of TEs.

Nevertheless, although bank efficiency has been extensively investigated in advanced economies, it has not received the deserved attention in TEs. So far, only relatively few studies have addressed the issue of bank efficiency in these countries and they are neither exhaustive nor conclusive. Furthermore, the banking sectors of TEs differ from those of advanced economies. For instance, in the bank dominated financial systems of TEs financial markets are underdeveloped and play a limited role contrary to the financial systems of advanced economies where financial markets play a very important role (Berglof and Bolton, 2002). In addition, as highlighted in detail in section 1.4 the banking sectors in transition economies have gone through dramatic structural changes during the first two decades of the transition process. They were liberalized, privatized, consolidated and experienced large influx of foreign investment (Fang et al., 2011) mostly as a result of several waves of reforms to the financial infrastructure applied by their respective governments in order to foster well-functioning banking sectors. Thus, the findings of the existing literature on advanced economies may not apply to TEs (Weill, 2003). The investigation of bank efficiency in TEs is also of timely interest given that several of these countries have already joined the EU while others have started negotiations for future accession and some others are expected to start soon. Additionally, a better understanding of the

factors that influence the efficiency of the banking sectors in TEs is important for both researchers and policy makers because, besides the divergence from advanced economies, these countries also have specific features that set them apart from each other and it is interesting to see whether banking sector development differs in relation to these specifics.

Most of the existing literature on bank efficiency in TEs has concentrated on measuring the relative efficiency of banks in terms of costs or profits whilst taking into account banks' size. The relatively new literature on bank efficiency in TEs has also focused on ownership and privatization, as determinants of efficiency (Kraft and Tirtiroglu, 1998; Opiela, 2000; Hasan and Marton, 2003; Weill, 2003; Fries and Taci, 2005; Kraft et al., 2002; Grigorian and Manole, 2006; Yildirim and Philippatos, 2007; Fang et al., 2011). However, to the best of our knowledge, the literature completely ignores an important dimension of the surrounding environment of TEs: the phenomenon of euroization. Euroization, which in general accounts for a process where the domestic currency is substituted by a foreign currency, is a defining characteristic of transition economies. Apart from contributing to the enrichment of the existing literature on banking efficiency in TEs, this thesis aims to fill this particular gap by investigating the impact of euroization on banking efficiency. More precisely, the thesis aims to address the question of what are the determinants of bank efficiency in TEs and whether a higher degree of euroization translates into higher or lower bank efficiency. Another related question is whether there are differences in the impact of the euroization at country level, which is outside an individual bank's control, and the euroization at bank level, which individual banks can manage. These questions are addressed by estimating cost efficiency of banks in TEs, using BankScope data for the period 2000-2013. The relative efficiency of banks is estimated through Stochastic Frontier analysis (SFA), a parametric approach for estimating the relative efficiency of banks, which explicitly accommodates multiple inputs and outputs and allows for the impact of environmental factors. Therefore in estimating the relative efficiency of banks in TEs, whilst taking into account euroization both at country and bank levels, this research aims to explore the extent to which euroization matters, and thus make a contribution to knowledge.

As emphasized above, euroization in the context of bank efficiency in TEs has not been addressed in the literature, so far. Given this, and the difficulty in adequately

capturing its real impact on bank efficiency due to the complexity of the risks associated with euroization, the thesis continues with a qualitative analysis of euroization. The qualitative analysis, at bank level in a few SEE countries is carried out to explore the approaches and attitudes of individual banks to euroization in more depth. Employing qualitative and quantitative research methods as complementary strategies in addressing the same research area and thus drawing on the respective strength of each method within the research design can provide a more complete picture of the phenomenon (Bryman, 2006; Gilbert, 2008; Silverman, 2011). More precisely, through this analysis, the thesis aims to explore the euroization strategy pursued by banks and the factors that influence that strategy, the instruments employed by banks to address risks related to euroization and the determinants of euroization through banks' perspectives. Taking into consideration that the research questions required exploration of the phenomenon without compromising the confidentiality of the participants, a qualitative analysis through semi-structured interviews was considered the most appropriate method. To the best of our knowledge, euroization, despite its prevalence in TEs, has been ignored in the qualitative research literature. Consequently, this study breaks new grounds with the potential for making a contribution to understanding some aspects of the euroization phenomenon. In addition, the thesis contributes to qualitative literature by identifying themes and conceptual frameworks related to euroization that could be further examined in future studies.

Building on the qualitative research, where we find that government policies such as macroprudential policy are becoming an important driver of de-euroization, the third part of the thesis investigates the impact of macroprudential policy on the level of credit euroization in TEs. Macroprudential policy is mainly focused on reducing systemic risk, and it has been actively used by TEs before and after the recent financial crisis (Lim et al., 2011), mostly due to their pronounced business cycles, their greater exposure to volatile international capital flows and other risks and their underdeveloped financial markets (Lim et al., 2011; Claessens et al., 2012). The literature on macroprudential policy and euroization, to the best of our knowledge, ignores the impact of macroprudential policy on euroization. However, taking into consideration that a group of macroprudential policy instruments are directly related to loans and deposits in foreign currency, it is to be expected that they may influence its level. The thesis aims to address this gap by investigating the impact of

macroprudential policy in TEs, for the period 2007-2013. The investigation in this chapter represents a first attempt of studying the potential impact of the macroprudential policy on financial euroization in TEs.

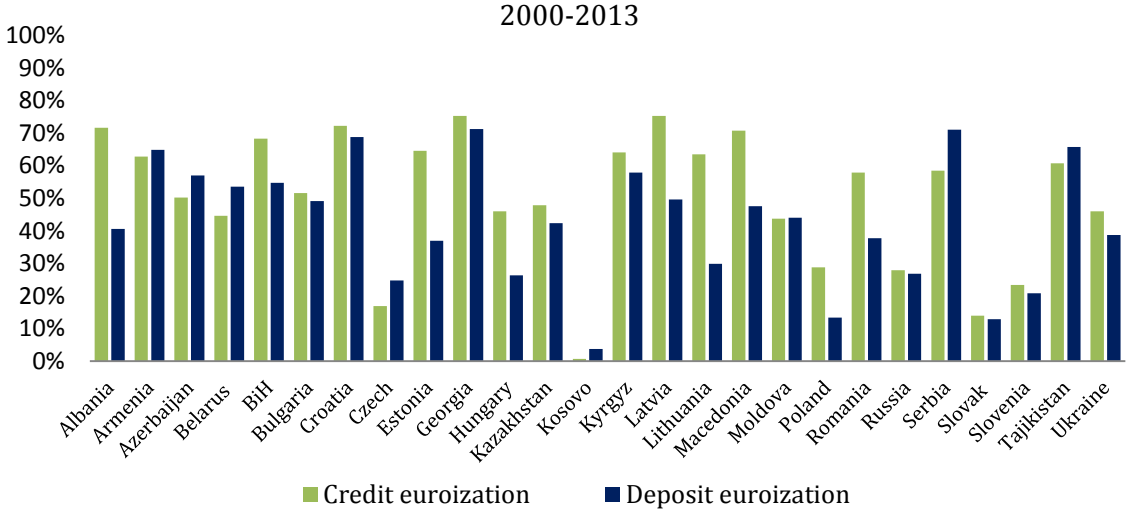
Thus, in summary the key research questions arising from these three main pillars of the thesis are:

1) What are the models and empirical evidence on bank efficiency and euroization in the literature? What are the gaps in knowledge in both areas?
2) What are the determinants of bank efficiency in TEs and in particular how does euroization affect bank efficiency?
3) What do banks regard as the main determinants of euroization? What are their strategies, policies, and procedures with regard to euroization? Do they feel that euroization affects their efficiency?
4) Does macroprudential policy have an impact on the level of credit euroization?

1.3 Euroization in transition economies (TEs)

This section attempts to draw an overall picture of euroization through a summary of the history and patterns of euroization in TEs, in order to provide the necessary background for the investigation of the research questions. The prevalence of euroization is a prominent feature of the TEs. Euroization, in general, accounts for a process where the domestic currency is substituted by a foreign currency (which in the countries under investigation is predominately the euro, but may also include other currencies). However, the literature identifies numerous types of euroization, which are discussed in detail in the following chapter. For the sake of this statistical overview we will limit the discussion to financial euroization which consists of credit euroization (the share of foreign currency loans in total loans) and deposit euroization (the share of foreign currency deposits in total deposits). As can be seen in Figure 1.1 financial euroization is remarkably prevalent in all TEs, though it varies quite a lot across different countries.

Figure 1.1 The average degree of credit and deposit euroization, 2000-2013

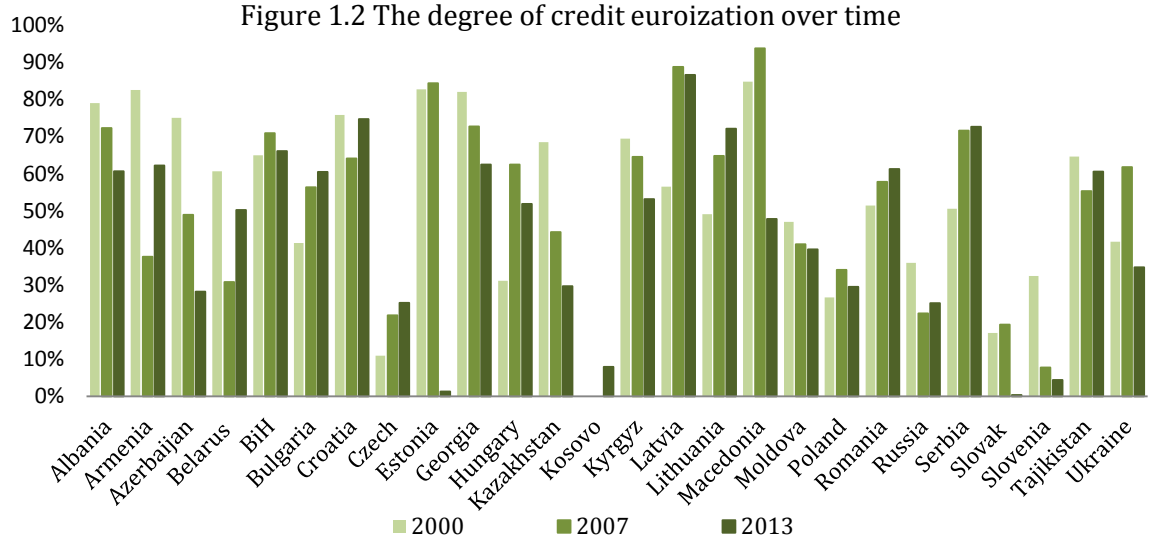


**For few countries in which the data was not available in 2000, the average from the earliest year available, usually 2002.*
Source: central banks, Monetary surveys (various years)

It is worth highlighting that for Kosovo, which has adopted euroization officially throughout the period, the degree of financial euroization, which represents the share of loans and deposits in currencies other than Euro, such as US dollar, Swiss Franc, etc., is very low. Considering the rest of the countries, Figure 1.1 shows that throughout the period 2000-2013 the average degree of credit euroization measured as the share of outstanding loans given to the non-banking sector denominated in a foreign currency in total loans, varies from 13% in the Slovak Republic to 77% in Albania. Whereas, the degree of deposit euroization measured as the share of foreign deposits in total deposits varies between 11% in Slovak Republic to 71% in Georgia.

Besides the variation across countries, it is also of importance to explore the degree of euroization over time. As documented in Figure 1.2 TEs are very diverse in this aspect as well.

Figure 1.2 The degree of credit euroization over time



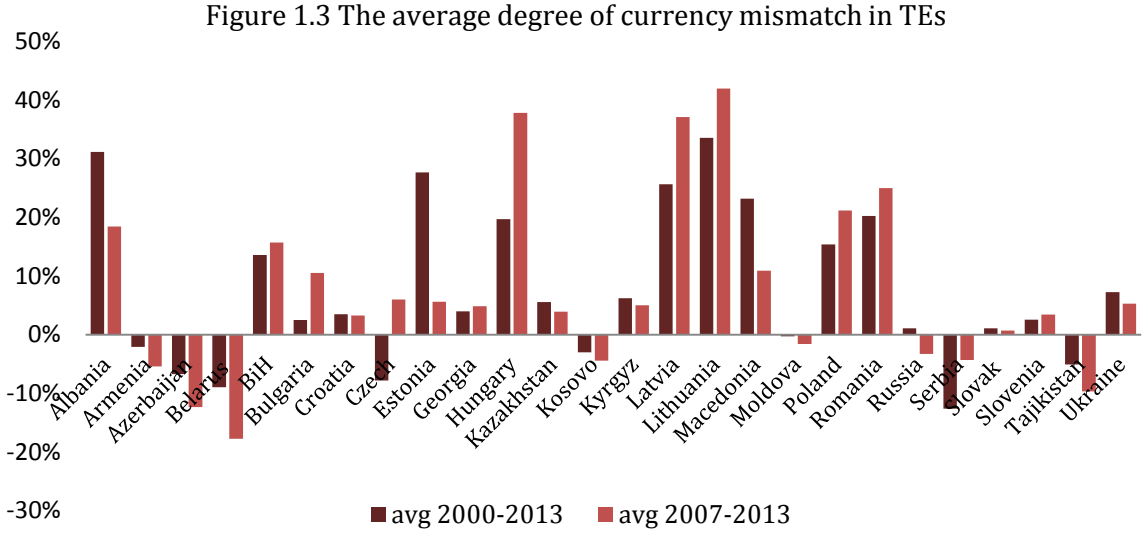
**For few countries in which the data was not available in 2000, the average from the earliest year available, usually 2002.*
Source: central banks, Monetary surveys (various years)

In countries such Albania, Azerbaijan, Georgia, Kazakhstan, Moldova and Slovenia credit euroization followed a decreasing trend from 2000 and onwards. However, in countries such as Bosnia and Herzegovina (B & H), Estonia, Hungary, Latvia, the Kyrgyz Republic, Macedonia, Poland, the Slovak Republic and Ukraine credit euroization was increasing until 2007 and only from then it had a decreasing trend. On the other hand in countries such as Armenia, Belarus, Croatia, Russian Federation and Tajikistan credit euroization was decreasing until 2007 and from then it had an increasing trend. In other countries such as Bulgaria, the Czech Republic, Kosovo, Lithuania, Romania and Serbia credit euroization has followed an increasing trend throughout the period. These different patterns make these countries interesting in exploring the implications of euroization in terms of bank efficiency but also in investigating the determinants of euroization.

As discussed in more detail later in section 2.3 the literature mostly investigates only deposit euroization and until very recently had ignored credit euroization. This was a result of several reasons. First and the main reason is data availability. Until recently, the data on deposit euroization was much more easily available than credit euroization. Second, the literature assumed that deposit and credit euroization mirror each other, because credit euroization is driven by deposit euroization due to strict regulatory requirements and banks' strategies in matching their balance sheet positions. Therefore, they maintained that by investigating deposit euroization one could also infer about credit euroization. However, a few recent studies have argued

that the degree of deposit euroization and credit euroization do not necessarily match across banking sectors in TEs. Figure 1.3 supports this view, showing that the average degree of currency mismatch, that is the difference between credit euroization and deposit euroization, in the same period, has been relatively high across TEs.

Figure 1.3 The average degree of currency mismatch in TEs

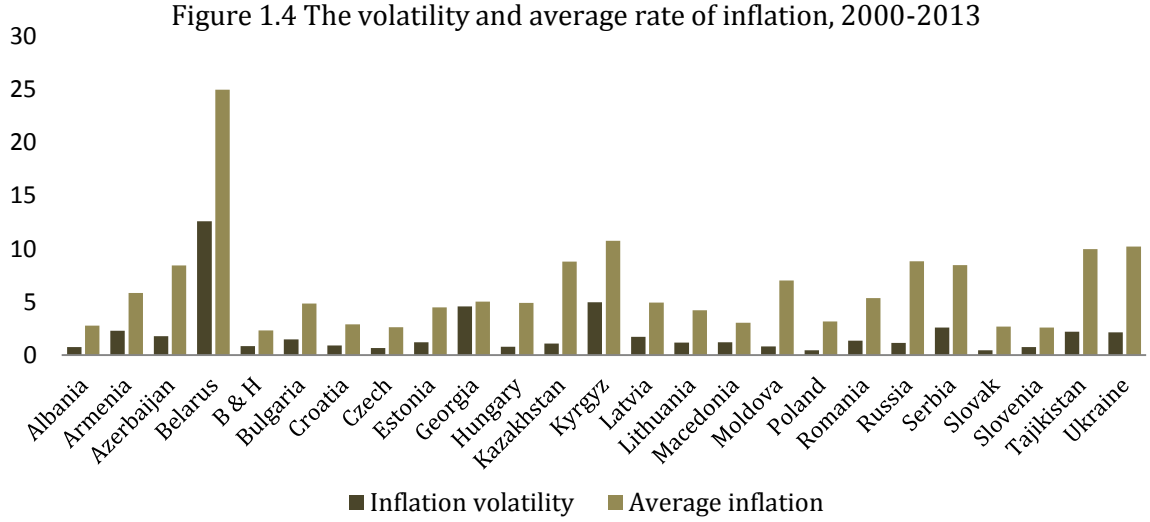


**For few countries in which the data was not available in 2000, the average from the earliest year available, usually 2002.*
Source: central banks, Monetary surveys (various years)

As seen above, in general, the banking sectors tend to be euroized more heavily on their assets side than on their liabilities side, which suggests that studies investigating deposit euroization in isolation have underestimated the degree of euroization. Thus, more research is needed to understand the causes and consequences of euroization in TEs. Here, too, there are striking differences across countries. The positive currency mismatch varies from 30% in Albania to 1% percent in Russia. The sign of the mismatch is negative in countries such as Armenia, Azerbaijan, Belarus, Czech Republic, Kosovo, Serbia, and Tajikistan, again with high variation from -13% in Serbia to around -1% in Armenia. If we focus on the average of degree of currency mismatch during the period 2007-2013, in most countries, the positive mismatch increases. In countries such as Armenia, Azerbaijan, Belarus and Tajikistan the negative mismatch deepens. Whereas, in few countries such as Albania, Bosnia and Herzegovina, Estonia, Macedonia and Ukraine, the mismatch is positive but lower than the average of the entire period.

Euroization is strongly associated with inflation volatility[1] and inflation itself. The literature has confirmed inflation volatility as a one of the main driver of euroization (for a detailed discussion see section 2.5.2). However, whilst this might be true for the first decade of transition, when, as explained in section 1.4.1, the inflation rate and inflation rate volatility were very high, it does not hold in the second decade of the transition process. As seen below in Figure 1.4 during this period the inflation volatility is low for most countries, with the exception of Belarus and Kyrgyz Republic, with the average inflation rate throughout the period 2000-2013 remaining low in most countries and moderately high in few.

Figure 1.4 The volatility and average rate of inflation, 2000-2013

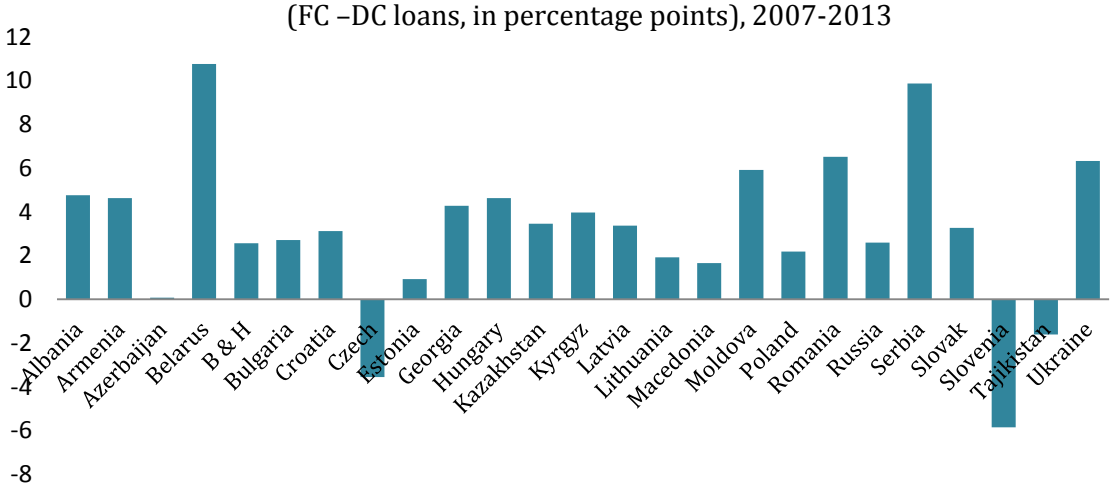


Source: World Bank, World Development Indicators 2015

Euroization is also linked to the interest rate differential, (the difference between the interest rate on foreign currency loans and domestic currency loans). The basic idea is that the higher the interest differential the higher the demand for foreign currency loans. A detailed discussion is given in section 2.5.2. Interestingly, the average interest rate differential is very low in some countries with a very high degree of euroization such as Estonia, Macedonia, and Lithuania. What is striking is that in few countries such as the Czech Republic, Slovenia and Tajikistan the interest rate differential is even negative. Whilst, this might be expected for the first two in which the degree of euroization is lower than the average in TEs, it is surprising for Tajikistan given the high degree of euroization. This is documented in Figure 1.5 presented below.

[1] In the context of the thesis inflation volatility is measured as standard deviation of the monthly inflation rate during one year.

Figure 1.5 Average interest rate differentials
(FC –DC loans, in percentage points), 2007-2013



Source: central banks (various reports and years)

Going further, theoretically, euroization is strongly associated with exchange rate volatility, which is directly affected by the type of exchange rate arrangement in the sense that higher flexibility leads to higher volatility (Flood and Rose, 1999). Almost half of TEs had adopted a floating rate in the early 1990s (Eichengreen and Haussman, 1999), which encouraged euroization. Later, due to the fear of the impact of high volatility against their major trading partners in their economy many of them have introduced currency board arrangements or pegged their exchange rate to euro or US dollar with only very limited flexibility (Calvo and Reinhart, 2002). Thus, exchange rate volatility remained low as it has been a policy objective. A snapshot of exchange rate arrangements in TEs in year 2013, as designed by the IMF, is provided in Table 1.1 where it is documented that a large number of TEs still have fixed exchange rate regimes.

Table 1.1 Exchange Rate Arrangements and Monetary Policy Frameworks in TEs, 2013

	Monetary Policy Framework				
	Exchange rate anchor		**Monetary aggregate target**	**Inflation-targeting framework**	**Other[1]**
Exchange rate arrangement	**U.S. dollar**	**Euro**			
No separate legal tender		Kosovo; Montenegro			
Currency board		B & H; Bulgaria; Lithuania[2]			
Conventional peg	Turkmenistan	Latvia[2]			
Stabilized arrangement		Macedonia	Tajikistan[3]; Ukraine[3]	Georgia[3]	Azerbaijan[3]
Crawl-like arrangement	Kazakhstan	Croatia	Uzbekistan[3]		
Other managed arrangement			Kyrgyz Rep.		Belarus; Russia[4]
Floating			Afghanistan	Albania; Armenia; Hungary; Moldova; Romania; Serbia	
Free floating				Czech Rep.; Poland	**EMU** Estonia; Slovak Rep.; Slovenia

1 They have no explicitly stated nominal anchor but monitor various indicators in conducting monetary policy.
2 The member participates in the European Exchange Rate Mechanism (ERM II).
3 The country maintains a de facto exchange rate anchor to the U.S. dollar.
4 The central bank has taken preliminary steps toward inflation targeting.
Source: IMF's Annual Report on Exchange Arrangements and Exchange Restrictions 2013

Foreign ownership in the banking sector of TEs, which has followed an increasing trend during the transition process (see section 1.4), has been identified in the literature as another determinant of euroization. The rapid increase in foreign ownership and euroization during the transition process has raised the interest of the researchers in investigating a possible causal relationship. However, as explained in detail in section 2.5.2, the literature is not unanimous on the impact of foreign ownership. Theoretically, it is expected to affect credit euroization positively given that it would lower the cost of funding in foreign currency and most of the studies document a positive relationship; however, there are studies that find a negative relationship or simply do not find a significant relationship between foreign ownership of banks and credit euroization.

To sum up, euroization has been an important phenomenon in many TEs that has persisted throughout the period despite the moderate inflation and exchange rate stability in many of these countries. Arguably, euroization remains an important feature of TEs, for which one must account for when investigating any important feature of these countries. In particular, low to moderate inflation rate and its volatility, low exchange rate volatility and low or even negative interest rate differential in most TEs with a high degree of euroization, suggest that the traditionally considered determinants do not fully explain the phenomenon in these countries during the last decade. Consequently, a further investigation of the determinants of euroization is an important addition to the literature.

1.4 Banking sector and economic development in TEs

This section aims at presenting an overview of the banking sectors in the TEs, outlining their main features and development in relation to the transition process, again in order to provide the necessary background for the research questions investigated.

1.4.1 First decade of the transition process

Before the transition towards market-based economies, the banking sector in most TEs was of a one-tier type, i.e. a mono-bank system where the bank was the central bank and the commercial bank simultaneously. In the one-tier systems, the mono-banks were responsible for the management of the central planning process and implementation of the payment plan among different state entities rather than financial intermediation. Lending activity was focused on crediting different state entities based on the central planning, irrespective of credit evaluation and risk management (Caviglia et al., 2002; Bonin and Wachtel, 2003). Thus, in fact it was an extension of government lending to other state entities and state owned enterprises to meet the general output plan. In few of the TEs, besides the mono-banks, there were few banks which were specialized along functional lines such as collecting deposits, crediting specific sectors (agriculture, construction, etc.) or dealing with foreign currency. However, they only played a secondary role alongside the 'mono'-

banks.[2] Consequently, the banking sector played only a limited role in promoting economic growth.

During the first decade of transition, which started in the early 1990s, the banking sectors of TEs were restructured from the one-tier system into a two-tier system. The two-tier system consisted of a Central Bank and separate commercial banks established out of the existing credit portfolios of the mono-bank. In this system, the central banks are responsible for the monetary policy, exchange rate policy, and regulation of the commercial banks, whereas commercial banks are responsible for financial intermediation. The initial restructuring proved unsuccessful in establishing well-functioning banking sectors in TEs. The newly established banking sectors were immediately faced with serious structural problems. First, although an objective of separating the functions of central banks from the commercial banks was to reduce the influence of the government in banking activities, this was not achieved. The degree of state-ownership within the banking sector remained high, given that the new commercial banks continued to be largely state owned in most TEs, which meant that the management of banking activities did not really change. Second, the degree of competition was very low immediately after the restructuring. In a few TEs, the entire credit portfolio of the mono-bank was transformed into one single state-owned bank.

Consequently, most of the TEs engaged in additional waves of restructuring to ensure a well-functioning banking sector. To address the problem of high degree of concentration and promote competition they introduced very lenient entry requirements for the newly established domestic banks. This increased rapidly the number of banks across TEs but introduced other problems. This meant a very heavy supervisory burden on the central banks, which were very inexperienced in this task (Berglof and Bolton, 2002). Second, due to relaxed regulatory entry requirements, most of the newly established banks were severely undercapitalized and lacked adequate banking experience (Bonin and Wachtel, 2003). In addition, as explained above, most of the newly established commercial banks had inherited the credit portfolios of the previous mono-bank (or specialized banks in few TEs). These banks continued to provide credit to state enterprises without applying any credit standards or risk management techniques. They behaved similarly with businesses

[2] For an elaborate discussion on the transition process in relation to banking sector, see Bonin and Wachtel (2003).

and individuals that had ties to the bank owners. Arguably, most of these new banks were mismanaged in the sense that they engaged in numerous episodes of speculation and fraudulent activities. Consequently, by mid 1990s, most TEs faced severe problems with the quality of banking sector portfolios. The share of non-performing loans in total loans increased dramatically in most TEs reaching about 31% in Albania; 38% in Czech Republic; 75% in Bulgaria; 75% in Macedonia; etc. As a result, a number of banks in these countries faced solvency problems. In the absence of adequate legislation and regulatory procedures to address these crises, the central banks encouraged the larger state-owned banks to acquire the smaller ones that faced solvency problems. This action backfired as it ended up weakening the large banks as well. All the above led to severe banking crises that seriously undermined confidence in banks in TEs (Berglof and Bolton, 2002).

The structure of the banking sectors in terms of the number of banks changed dramatically during 1990s. From the one-tier system with a mono-bank, and in some cases with few additional specialized banks, the number of banks increased dramatically in most of the TEs, reached double and in some even triple digits by early 1990s. This mostly reflects the initial restructuring and very lenient licencing regulations mentioned before. Then the number of banks decreased rapidly by mid-1990s reflecting the banking crises in these TEs. This is documented in Table 1.2 presented below.

Table 1.2 Number of banks in selected TEs during the first decade

	1994	1995	1996	1997	1998	1999	2000
Albania	6	6	8	9	10	13	13
Armenia	41	35	33	30	31	32	31
Azerbaijan	210	180	136	99	79	70	59
Belarus	48	42	38	38	37	36	31
Bulgaria	40	41	42	28	34	34	35
Croatia	50	54	57	61	60	53	43
Estonia	22	18	15	12	6	7	7
Georgia	226	101	61	53	42	36	30
Kazakhstan	184	130	101	82	71	55	48
Kyrgyz	18	18	18	20	23	23	22
Latvia	56	42	35	32	27	23	21
Lithuania	22	12	12	11	12	13	13
Macedonia	6	6	8	9	24	23	22
Moldova	21	22	21	22	23	20	20
Poland	82	81	81	83	83	77	73
Russia		2,295	2,029	1,697	1476	1349	1311
Slovenia	44	41	36	34	30	31	28
Ukraine	228	230	229	227	175	161	154

Source: EBRD, Transition Reports (various years) and central banks (annual reports, various years)

In countries such as Azerbaijan, Georgia, Lithuania, Moldova and Tajikistan banking crises of the 1990s were further exacerbated by the macroeconomic turbulences that these countries experienced in the early stages of transition. On the other hand, the banking crises themselves prolonged or worsened the macroeconomic conditions in many TEs, particularly in countries such as Azerbaijan, Kazakhstan and Georgia.

Although transition countries began the transition process with very different initial conditions and later followed very different paths and speed of transition, most of them experienced a major output decline in the early 1990s. However, when analysing economic indicators in TEs, one must recall the data limitation, pointed out by Berglof and Bolton (2002), that in the early phases of transition process, real GDP statistics were of suspicious quality because of high and variable levels of inflation and, thus, these data should be interpreted with caution. Table 1.3 shows the development of GDP growth during the period 1992-2000. Unfortunately, the data for the earlier years of transition is not available for a number of TEs.

Table 1.3 Annual real GDP growth (in percent) TEs, 1992-2000

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Albania	-7.2	9.6	8.3	13.3	9.1	-10.2	12.7	10.1	7.3
Armenia	-41.8	-8.8	5.4	6.9	5.9	3.3	7.3	3.3	5.9
Azerbaijan	-22.6	-23.1	-19.7	-11.8	1.3	5.8	10.0	7.4	11.1
Belarus	-9.6	-7.6	-11.7	-10.4	2.8	11.4	8.4	3.4	5.8
B & H				20.8	89.0	34.4	15.6	9.6	5.5
Bulgaria	-7.3	-1.5	1.8	2.9	1.6	-1.1	3.5	-5.6	6.0
Croatia					5.9	6.6	1.9	-0.9	3.8
Czech	-0.5	0.1	2.9	6.2	4.3	-0.7	-0.3	1.4	4.3
Estonia					5.9	11.7	6.8	-0.3	9.7
Georgia	-44.9	-29.3	-10.4	2.6	11.2	10.5	3.1	2.9	1.8
Hungary	-3.1	-0.6	2.9	1.5	0.0	3.4	4.2	3.2	4.2
Kazakhstan	-5.3	-9.2	-12.6	-8.2	0.5	1.7	-1.9	2.7	9.8
Kyrgyz	-13.9	-15.5	-20.1	-5.4	7.1	9.9	2.1	3.7	5.4
Latvia	-32.1	-5.0	2.2	-0.9	3.8	8.3	4.7	4.7	6.9
Lithuania	-21.3	-16.2	-9.8	3.3	5.2	7.5	7.6	-1.1	3.3
Macedonia	-6.6	-7.5	-1.8	-1.1	1.2	1.4	3.4	4.3	4.5
Moldova	-29.1	-1.2	-30.9	-1.4	-5.2	1.6	-6.5	-3.4	2.1
Poland	2.5	3.7	5.3	7.0	6.2	7.1	5.0	4.5	4.3
Romania	-8.8	1.5	4.0	7.2	4.0	-6.1	-4.8	-1.2	2.1
Russia	-14.5	-8.7	-12.6	-4.1	-3.6	1.4	-5.3	6.4	10.0
Serbia					2.4	7.2	2.4	-12.1	7.8
Slovak		1.9	6.2	5.8	6.8	6.1	4.0	-0.2	1.2
Slovenia					3.5	5.1	3.3	5.3	4.2
Tajikistan	-29.0	-16.4	-21.3	-12.4	-16.7	1.7	5.3	3.7	8.3
Turkmenistan	-15.0	1.5	-17.3	-7.2	6.7	-11.4	7.1	16.5	5.5
Ukraine	-9.7	-14.2	-22.9	-12.2	-10.0	-3.0	-1.9	-0.2	5.9

Source: World Bank, World Development Indicators 2015

As Table 1.3 shows, these TEs differed considerably in the extent of the output decline and in terms of the speed of the recovery. Ukraine and Azerbaijan experienced the deepest recession, whereas Slovak Republic weathered this period of transition better than most in terms of GDP growth.

In addition, in the early stage of the transition process TEs were experiencing high rates of inflation, some of them even experiencing hyperinflation as shown in Table 1.4. The high volatility of rates of inflation with hyperinflation in some countries was a major factor in the high degree of euroization, which is further discussed in the next section.

Table 1.4 Annual rate of inflation in selected TEs, 1990-2000

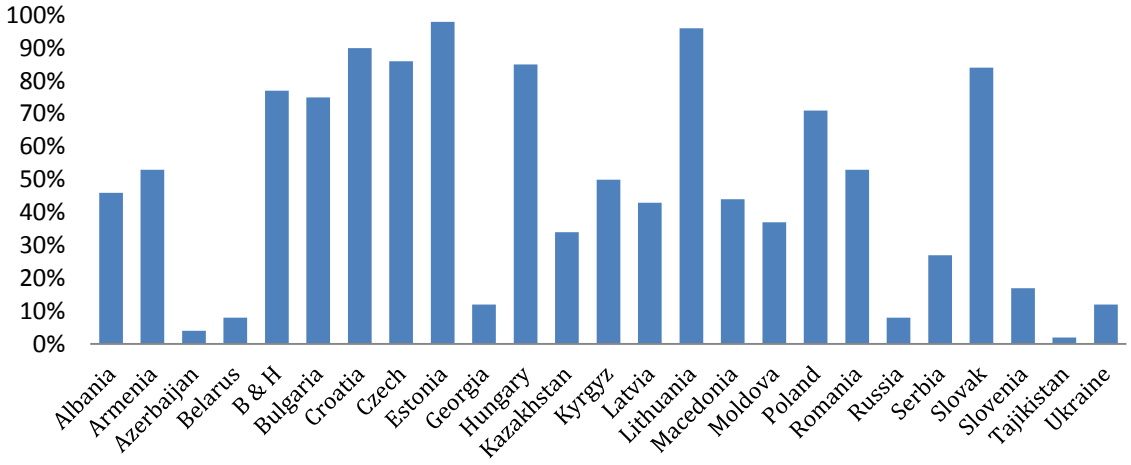
	1993	1994	1995	1996	1997	1998	1999	2000
Albania	85.0	22.6	7.8	12.7	33.2	20.6	0.4	0.1
Armenia		3373.5	176.0	18.7	14.0	8.7	0.7	-0.8
Azerbaijan	1128.0	1662.2	411.8	19.8	3.7	-0.8	-8.5	1.8
Belarus	1190.2	2221.0	709.4	52.7	63.9	72.9	293.7	168.6
Bulgaria	72.9	96.1	62.1	121.6	1058.4	18.7	2.6	10.3
Croatia	1500.0	107.3	4.0	4.3	4.2	6.4	4.0	4.6
Estonia	89.8	47.7	28.8	23.1	10.6	8.2	3.3	4.0
Georgia			162.7	39.4	7.1	3.6	19.2	4.1
Hungary	22.5	18.9	28.3	23.4	18.3	14.2	10.0	9.8
Kazakhstan		1877.4	176.2	39.2	17.4	7.2	8.3	13.2
Latvia	108.8	35.9	25.0	17.6	8.4	4.7	2.4	2.7
Lithuania	410.2	72.2	39.7	24.6	8.9	5.1	0.8	1.0
Macedonia		126.6	16.4	2.5	1.3	0.5	-1.3	6.6
Poland	36.9	33.3	28.1	19.8	15.1	11.7	7.3	10.1
Romania	255.2	136.8	32.2	38.8	154.8	59.1	45.8	45.7
Russia	874.6	307.6	197.5	47.7	14.8	27.7	85.7	20.8
Serbia			82.7	95.6	23.3	30.2	42.5	71.1
Slovenia	32.9	21.0	13.5	9.8	8.4	7.9	6.2	8.9
Ukraine	4734.9	891.2	376.8	80.3	15.9	10.6	22.7	28.2

Source: World Bank, World Development Indicators 2015

The difficult macroeconomic environment combined with banking crisis meant that the full extent of the crisis of the 1990s would not be recognized for several years. Nevertheless, most TEs attempted to address the above distortions in their banking sectors through several waves of restructuring. Initially they attempted to address the problem of the existing non-performing loans in their banking sectors either through recapitalization of banks or through writing off the bad loans (Bonin, 2001). However, this proved unsuccessful and paved the way for the privatization of state-owned banks. TEs turned to privatization to diminish the government's influence on banking activity and, at the same time, to bring in better risk management techniques and disciplined risk taking (Reininger et al., 2002). The privatization of the banking

sector led to a rapid increase in foreign ownership within the banking sectors in all TEs. As seen in Figure 1.6 by the year 2002 the average degree of foreign ownership had reached around 50%.

Figure 1.6 The degree of foreign bank ownership in TEs, 2002



Source: EBRD, Transition Report, 2002

Besides privatization, most TEs were actively engaged in reforming their banking sectors during the first decade of the transition process and were successful in this regard. One measure of their progress is banking sector reform index (BSRI) produced by the European Bank for Reconstruction and Development (EBRD) which ranks countries on a scale of 1 to 4+, in their progress in liberalisation and institutional reform of the banking sector. A score of 1 represents little change from a socialist banking sector apart from the separation of the central bank and commercial banks, while a score of 4+ represents a level of reform that approximates the institutional standards and norms of an industrialised market economy. As can be seen in Table 1.5 although most TEs started with the lowest value of the BSRI; by the mid-1990s they had reached a value of 2 or higher, implying that all of them had achieved some progress in the development of banking sectors, although much remained to be done. By 1999, the highest banking reform index observed was in Hungary, which suggests that its banking sector was four stages behind the banking sectors of the developed countries.

Table 1.5 The Banking Sector Reform Index (BSRI) in TEs, 1991-1999

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Albania	1	1	1.3	2	2	2	2	2	2
Armenia	1	1	1	1	2	2	2.3	2.3	2.3
Azerbaijan	1	1	1	1	2	2	2	2	2
Belarus	1	1	1	1	2	1	1	1	1
Bulgaria	1	1.7	2	2	2	2	2.7	2.7	2.7
Croatia	1	1	2	2.7	2.7	2.7	2.7	2.7	3
Czech	2	3	3	3	3	3	3	3	3.3
Estonia	1	2	3	3	3	3	3.3	3.3	3.7
Georgia	1	1	1	1	2	2	2.3	2.3	2.3
Hungary	2	2	3	3	3	3	4	4	4
Kazakhstan	1	1	1	1	2	2	2.3	2.3	2.3
Kyrgyz	1	1	1	2	2	2	2.7	2.7	2.3
Latvia	1	2	2	3	3	3	3	2.7	3
Lithuania	1	1	2	2	3	3	3	3	3
Macedonia	1	1	1.3	2	3	3	3	3	3
Moldova	1	1	2	2	2	2	2	2.3	2.3
Poland	2	2	3	3	3	3	3	3.3	3.3
Romania	1	1	1	2	3	3	2.7	2.3	2.7
Russia	1	1	1	2	2	2	2.3	2	1.7
Slovak	2	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Slovenia	1	2	3	3	3	3	3	3	3.3
Tajikistan	1	1	1	1	1	1	1	1	1
Ukraine	1	1	1	1	2	2	2	2	2

Source: EBRD, Transition Reports (various years)

To sum up, the first decade of transition process saw progress in the banking sectors, although the progress was uneven and unsatisfactory. Most countries suffered output decline and high inflation (some even hyperinflation), however, the scale of these recessions varied widely across countries. The main achievement of this period for the banking sector was the break-up of the one-tier system and its replacement by a two-tier system. The privatization and restructuring of the state owned banks and the entry and development of new domestic and foreign banks were also a significant achievement (Claessens et al., 2001). Finally, although the regulatory and supervisory framework was improved substantially during the period, its enforcement remained a problem in many countries. In conclusion, given the macroeconomic turbulence, in spite of several waves of restructuring during the first decade of transition, the general progress was not satisfactory; hence, the banking crises were happening frequently.

1.4.2 The later stage of transition process

In contrast to the macroeconomic turbulence experienced during the first decade of transition, in the second decade most TEs achieved macroeconomic stabilization and

established the foundations of a market economy. Although, initial conditions were important to how these countries weathered this period, the policies undertaken were the critical component. The countries with better initial conditions and those that undertook more aggressive and radical reform, such as the Central European and then the Baltic states, achieved stabilization and returned to growth faster (Roaf et al., 2014).

The reforms undertaken during the first decade of transition, combined with adequate monetary and fiscal policies, enabled the achievement of a stable macroeconomic environment in most of the TEs by early 2000s. Although, these countries followed relatively different paths with regard to economic performance, all of them recorded positive average GDP growth over the period 2000 to 2013 (Figure 1.7).

Figure 1.7a Average annual GDP growth (in percent) in TEs, 2000-2013

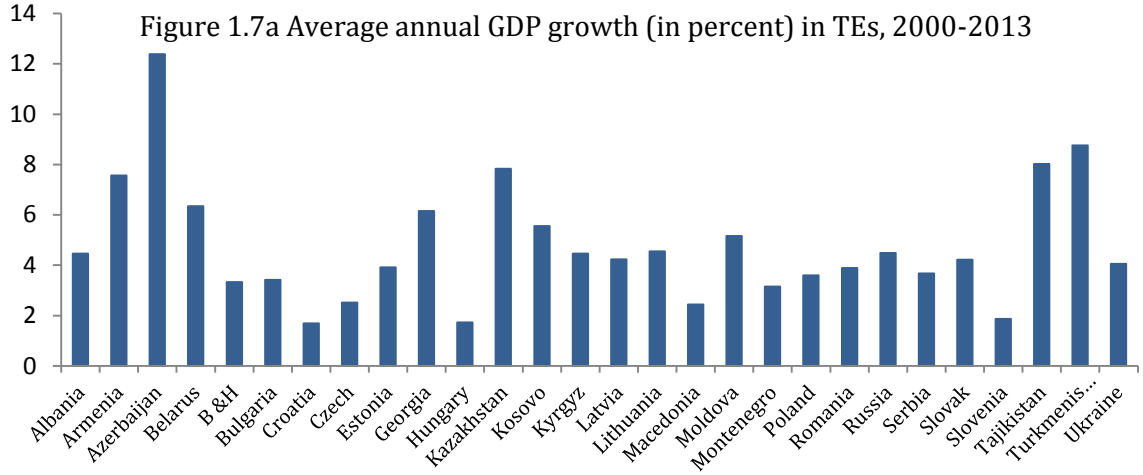
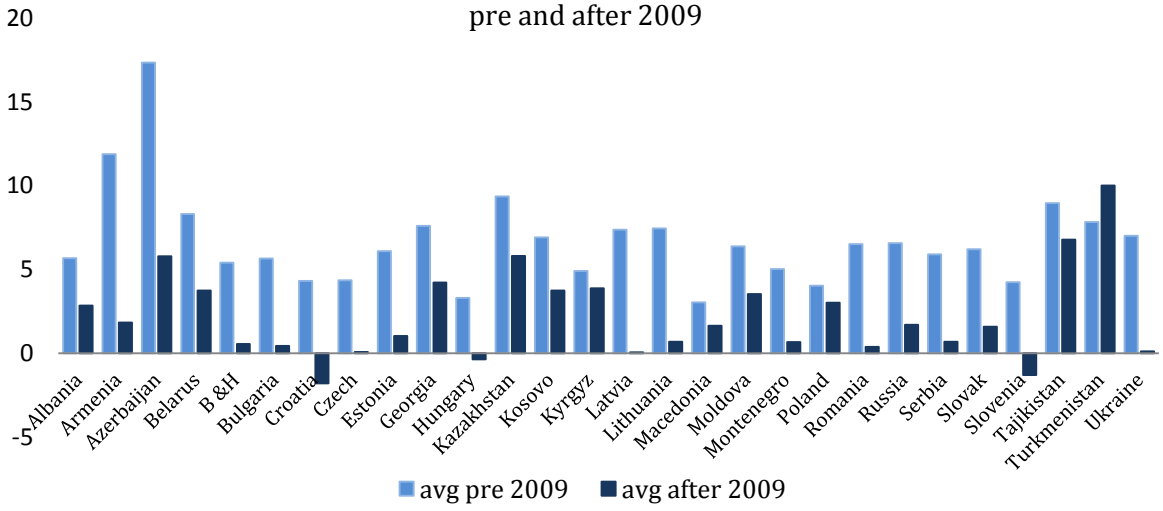


Figure 1.7b Average annual GDP growth (in percent) in TEs, pre and after 2009



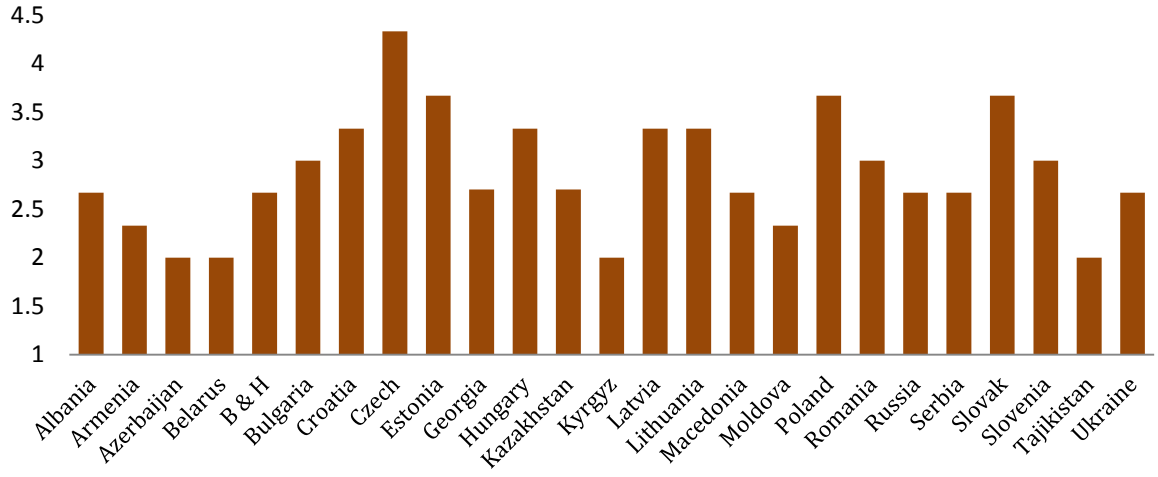
**For countries in which the data was not available in 2000, the average from the earliest year available.*
Source: World Bank, World Development Indicators 2015

Of course the diagram showing the average rates of grow (Fig 1.7a) does not pick up the effect of the latest Global Financial Crisis (GFC). As Figure 1.7b shows most of the TEs continued to record positive GDP growth up until 2009 when the effects of the Global Financial Crisis (GFC) reached these countries. Most of the TEs weathered the crisis relative well, the exceptions being Croatia, Hungary, Latvia and Slovenia, which recorded negative average GDP growths in this latter period.

During the second decade of transition, most TEs were also successful in bringing down the inflation in comparison to the first decade. As Figure 1.4, shows the average inflation rate throughout the period 2000-2013 is moderate, with the exception of Belarus, Romania, Russia, Serbia, Tajikistan and Ukraine which were not successful in bringing the average rate of inflation rate down to single-digit values. Nevertheless, the situation is much more stable than that of the 1990s in which some of the TEs were still experiencing hyperinflation.

In this period, TEs recorded remarkable progress in terms of banking sector reforms. Figure 1.8 below shows the values of the BSRI across TEs in 2013, and demonstrate substantial improvement from the situation in the 1990s (details of which were given in Table 1.3). In few countries, such as Estonia, Poland and Slovak Republic, the BSRI index is higher than 3+, suggesting that the banking sectors of these countries achieved substantial progress.

Figure 1.8 The Banking Sector Reform Index in TEs, 2013



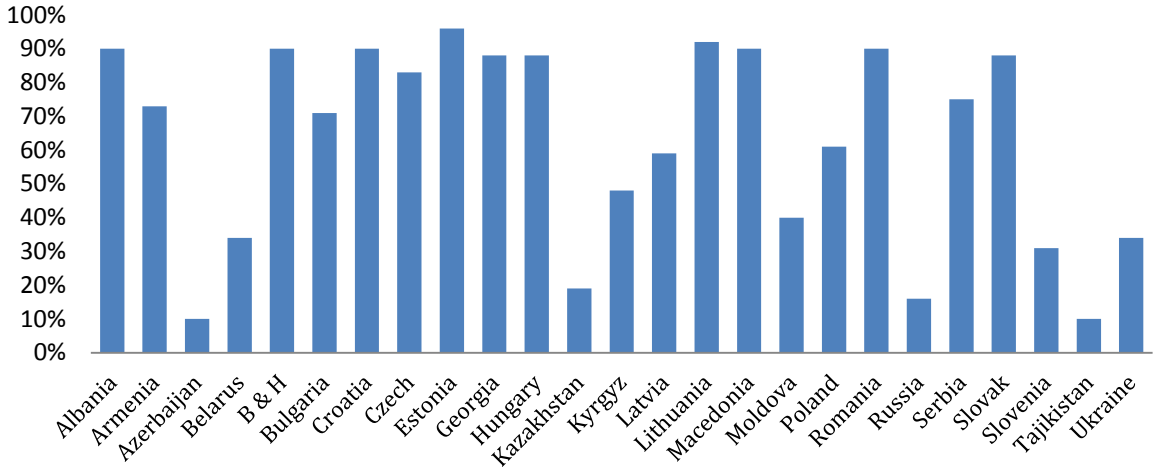
Source: EBRD, Transition Report 2013

The highest banking reform index was observed in the Czech Republic suggesting its banking sector is almost on par with the banking sectors of the developed countries.

In this respect, the TEs that have joined the EU have been able to record the highest progress, whilst large differences remain amongst the remaining TEs.

In addition, during the second decade of transition, the degree of foreign ownership in banking sectors continued to have a positive trend in nearly all transition countries. The only exceptions are Kazakhstan, Kyrgyz Republic, and Poland, in which the degree of foreign ownership has actually decreased in the last ten years. As shown in Figure 1.9 by 2013 in most of these banking sectors foreign owned banks dominated the banking sector by controlling more that 90% of the market. In only five countries, Azerbaijan, Belarus, Kazakhstan, Russia, and Tajikistan, foreign owned banks controlled less than 20% of the banking sector's assets.

Figure 1.9 The degree of foreign bank ownership in TEs, 2013



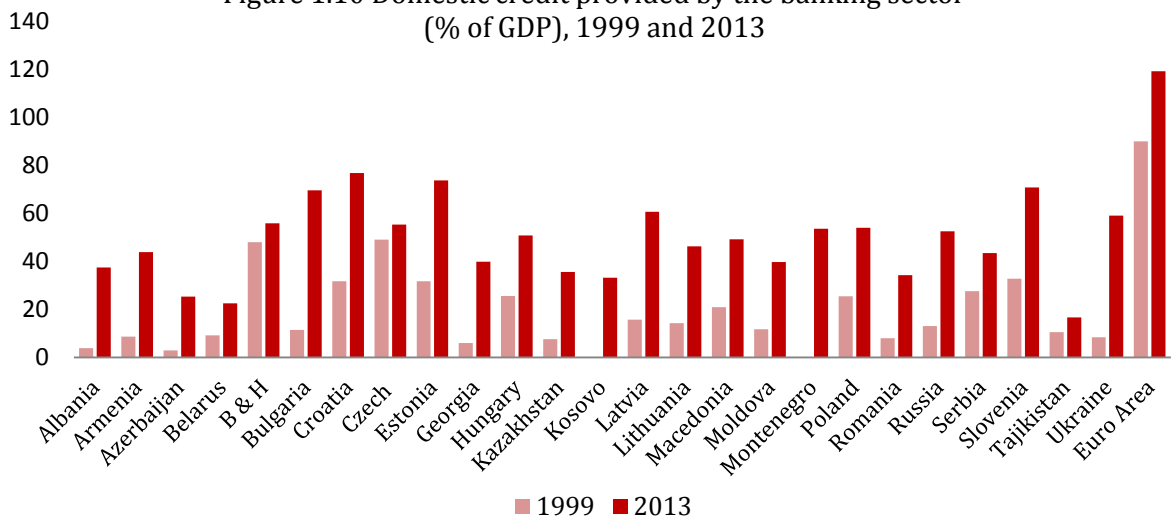
Source: EBRD, Transition Report 2013

Foreign bank ownership remains an important feature of TEs, for which one must account for when conducting any banking/financial sector investigation in these countries. In addition, most of the literature on bank efficiency in TEs finds foreign ownership a determinant of banking efficiency in these countries, an area further discussed in Chapter 3. The thesis will examine the relationships between euroization, bank efficiency and foreign ownership. The differences across countries in terms of foreign ownership and euroization enable an interesting exploration of the implications of the two phenomena for bank efficiency.

In spite of a stabilized macroeconomic environment, several waves of banking sector restructuring, privatization that led to the increased degree of foreign ownership, which should have increased the efficiency of the banking sector, TEs continue to lag

behind the banking sectors of the Euro Area in terms of the depth of financial intermediation. In most TEs the degree of financial depth, measured by domestic credit provided by the banking sector as a share of GDP was below 60% in 2013, which although, as seen in Figure 1.10, represents considerable improvement in comparison with the end of the first decade, it is still only half of the average depth in the Euro Area.

Figure 1.10 Domestic credit provided by the banking sector (% of GDP), 1999 and 2013



Source: World Bank, World Development Indicators 2015

As expected the highest degree of development are observed in the EU member countries, suggesting that the EU integration process might have had an important role in the development of the banking sector. Thus, in other TEs the banking sector has yet to fully develop its role in financial intermediation and, as argued in section 1.2, facilitating economic growth. Taking into consideration this gap and that banking sectors dominate the financial system in TEs, a situation that is unlikely to change soon, the importance of the banking sector for economic growth means that there is much value in further research into the determinants of banks' efficiency in TEs.

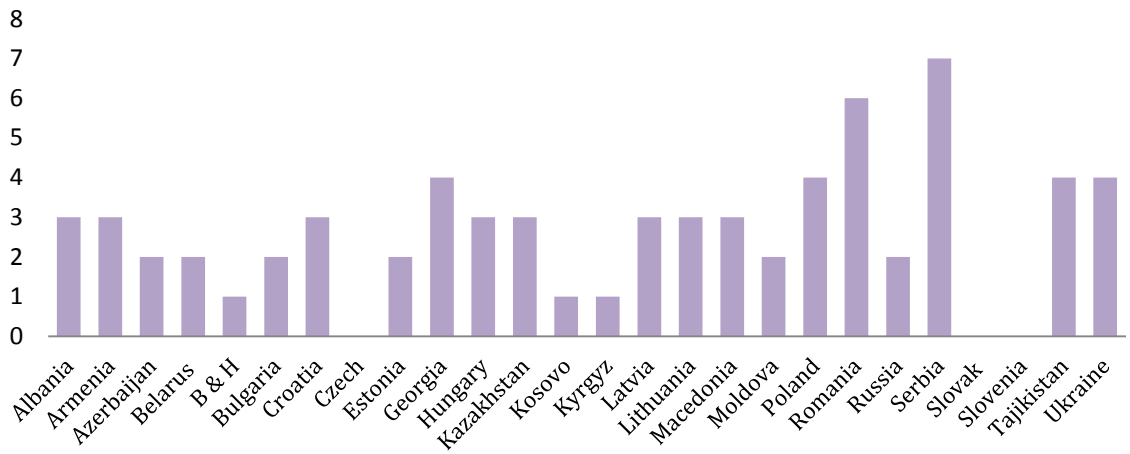
1.5 Macroprudential policy in TEs

Macroprudential policy is widely considered a useful response to global financial crisis by many countries. As a policy, it is focused on addressing financial stability through reduction of the systemic risk "by explicitly addressing the interlinkages between, and common exposures of, all financial institutions, and the procyclicality of the financial system" (Caruana, 2010). A detailed discussion is given in section 6.2.

Taking into consideration the positive impact of euroization on systemic risk (see section 2.4) macroprudential policy addresses the phenomenon of euroization as well, thus it is of interest for policy makers to assess the impact of macroprudential policy on euroization. Emerging market economies, which are highly euroized and have pursued this type of policy mostly due to their pronounced business cycles, their greater exposure to volatile international capital flows and their underdeveloped financial markets (Lim et al., 2011; Claessens et al., 2012) are considered a good sample for investigating the impact of the macroprudential policy on euroization.

A wide range of macroprudential policy instruments (MPIs) have been applied throughout the period under consideration in different countries. In the context of this thesis, however, the most important ones are the macroprudential policy instruments that are directly related to credit and deposit euroization, and which are expected to influence the level of euroization. As Figure 1.11 shows these MPIs have been actively used in TEs, making this region an interesting area for investigating their impact on euroization.

Figure 1.11 The number of MPIs related to euroization employed in TEs, 2000-2013



Source: central banks (annual reports various years) and the IMF's Global Macroprudential Instruments Database, 2015

The figure above shows that there is variation across TEs in terms of the number of MPIs directly related to euroization introduced throughout the period. Most countries have introduced at least one instrument. We can see that from our sample Serbia is the country with the highest number of instruments introduced, followed by

Romania. In contrast, three countries: the Czech Republic, Slovakia and Slovenia have not introduced any instruments related to foreign currency positions.

Given the importance of various policies aimed at macroeconomic stabilization and banking sector development employed in TEs, it is important to investigate their impact on the level of credit euroization in these countries.

1.6 The organization of the thesis

This chapter has highlighted the importance of the overall research undertaken in the thesis. It has provided the background information on the phenomenon of euroization, the development of the banking sector and macroeconomic environment throughout the two decades of transition in these countries. We now turn to explanation of the structure of the thesis, focussing on the content and role of the following chapters.

The first research question is addressed through a review of the literature of euroization and bank efficiency presented in Chapters 2 and 3. In Chapter 2, the existing theoretical and empirical research on euroization, its determinants and its impact on banking sector performance is critically reviewed. In Chapter 3, the literature on bank efficiency, on the methodological issues related to the measurement of efficiency and its determinants with particular focus on the literature in TEs, is discussed. Providing an exhaustive and comprehensive review of literature on euroization and bank efficiency is beyond the scope of this thesis. Nevertheless, the focused reviews of the main contributions to the literature in these areas aim to identify the gaps in the literature, which are then addressed through the empirical work presented in the subsequent chapters. Thus, the literature reviews in Chapters 2 and 3 are used to establish the research hypothesis regarding the impact of euroization on banks' efficiency and to identify the determinants of financial euroization.

The empirical work in this thesis consists of three different investigations and is presented in Chapters 4, 5, and 6. In Chapter 4, the empirical investigation of the impact of euroization on bank efficiency in TEs is presented. Following the literature review on bank efficiency, provided in Chapter 3, the relative cost efficiency of banks is estimated employing the stochastic frontier analysis (SFA), explicitly incorporating

financial euroization and the risk factors in the model. This study broadens the literature by investigating possible links between financial euroization and bank efficiency. Additionally, by covering an extended period (15 years), the study considers a longer period than has previously been available.

A qualitative analysis of euroization at bank level is presented in Chapter 5. Building on the empirical research presented in the Chapter 4, we turn to qualitative analysis to further explore and better understand the phenomenon of euroization as seen from the bank's point of view. The investigation is conducted using semi-structured face-to-face interviews carried out in the natural settings of individual banks operating in two SEE countries: Albania and Macedonia. The chapter provides evidence that macroprudential policies are affecting the policies and procedures employed by banks in SEE countries, and are becoming an important driver of de-euroization.

As an extension to the qualitative analysis presented in Chapter 5, the impact of macroprudential policy instruments on euroization in transition economies is empirically investigated in Chapter 6. This analysis is conducted for 25 TEs over the period 2007-2013, using panel data techniques that incorporate a dynamic element. The chapter broadens the literature on euroization and macroprudential policy and provides policymakers in TEs, with information on the impact of existing macroprudential policy instruments on financial euroization so that they can make informed policy decision on the design and implementation of future policy.

The concluding chapter, Chapter 7, synthesises the main findings of the thesis in relation to the key research questions and discusses their implications in terms of policymaking in TEs. The chapter highlights the key contributions of the thesis to the literature on bank efficiency, euroization, and macroprudential policy. The chapter also draws attention to limitations of the work presented and identifies possible areas for further research.

Chapter 2

Euroization: A critical review of the literature

2.1 Introduction

Having highlighted the importance of euroization in the context of TEs in Chapter 1, we turn to the review of the literature on euroization and bank efficiency, which are presented separately in Chapters 2 and 3. This chapter reviews the main theoretical approaches and empirical literature on euroization, focusing on the determinants of euroization and its impact on financial system, particularly on banking sector performance. The literature on euroization is vast and diverse; as the phenomenon has been investigated from different perspectives. However, as explained in Chapter 1 although there are many studies that investigate the impact of euroization on other banking performance indicators, to the best of our knowledge, none of them focus on efficiency. To identify the extent and the nature of the impact euroization on bank efficiency in these countries it is arguably necessary to better understand what drives euroization in these countries in the first place. Despite the extensive literature analysing the determinants of euroization, the existing research seems to be limited in its ability to explain euroization in TEs and ignores the possible impact of macroprudential policy. Providing an exhaustive and comprehensive review of euroization literature is beyond the scope of this thesis; however, this chapter aims to provide a concise critical review of the main literature on different approaches to euroization. Consequently, this chapter will provide the basis upon with the research hypothesis regarding the impact of euroization on bank efficiency and on the determinants of financial euroization will be developed. Thus, the chapter will serve as the basis for the empirical research presented in Chapters 4, 5 and 6.

The rest of the chapter is structured in the following manner. Section 2.2 initially addresses the phenomenon of euroization in general, it then continues with an explanation of a number of definitions euroization used in the literature in order to clarify what is used in this thesis. Section 2.3 elaborates on the origins of the process of euroization. The discussion of the main theoretical approaches on explaining the extent of euroization is provided in section 2.3. The following section identifies the role of and consequences of euroization by breaking down its main advantages and disadvantages to the economy. A critical review of the empirical literature is provided in section 2.5. The discussion is structured in three parts with the first tackling the measurement problem in relation to existing research on euroization. The second

part seeks to establish the drivers of euroization in TEs, while the third part examines the impact of euroization on the financial system. A brief conclusion is offered in the last section.

2.2 Important definitions and concepts

Euroization occurs when the domestic currency is substituted by a foreign currency. In the theoretical and empirical literature, euroization is usually referred to as dollarization. This is because for a long time US Dollar was the main currency that was used as a substitute for the domestic currency, with countries involved mainly located on the American continent. However, lately Euro and Yen have emerged as serious competitors to US Dollar in European and Asian countries, respectively. Thus, the choice of the foreign currency is heavily depended on where the process is taking place. This research will cover transition economies in Europe, that now mostly use Euro as a substitute for the domestic currency and, therefore, the term Euroization will be used throughout the thesis.

The word 'euroization' has been used in different ways in the literature and we first make clear what is the definition in this thesis. There are also differences in the extent of substitution and on the money function for which the substitution takes place, depending on who initiates it, and the literature defines different sub-types of euroization. In the following subsections, these definitions are further explored.

2.2.1 Official and unofficial euroization

Some literature differentiates between 'official euroization' and 'unofficial euroization' (Berg and Borensztein, 2000; Eichengreen, 2002; Calvo, 2002; Levy Yeyati and Sturzenegger, 2003; Jacome and Lonnberg, 2010). In this literature, 'official euroization' refers to the government-led complete abandonment of the domestic currency and adoption of a foreign currency as the only legal tender in the economy. This is not the use of the term 'euroization' in this thesis, which is not concerned with the adoption of the euro as the official currency, but with the use of the euro and/or other foreign currencies partly substituting the domestic currency of the country in specific functions (what this literature terms 'unofficial euroization'). This euroization is initiated by economic agents such as households and firms, not

governments. In the period covered by this thesis several countries have formally (and with the agreement of the European Commission) joined the European Monetary System: Slovenia in 2007, Slovakia in 2009, Estonia in 2011 (EC, 2015). Others have unilaterally adopted the euro: Kosovo and Montenegro substituted the Serbian Dinar with the German DM in the late -1990s and subsequently substituted the DM with the Euro. In these countries, the foreign currency that had been held as the major component of their 'euroization', the euro, switched to become the domestic currency at the adoption dates. The measurement of 'euroization' as referred to in this thesis in these countries then became in terms of other currencies used and was considerably reduced in size.

2.2.2 Financial, payment and real euroization

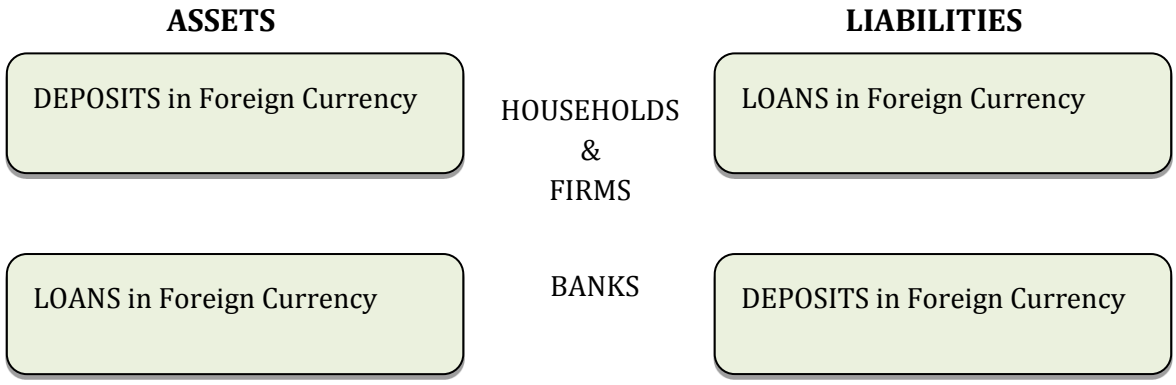
In euroization, the domestic currency can be substituted by the foreign currency in one or in all of its main functions. Money has three main traditional functions: medium of exchange, unit of account and store of value. As the medium of exchange or means of payment, money facilitates exchange and settles payments. Thus, is synonymous with the circulating means of payment, whose main attribute according to Cohen (2004, p.1) is "its general acceptability to satisfy contractual obligations". As the unit of account money acts as an abstract unit in which contracts, prices and debts are expressed (Rochon and Rossi 2003, p.4), thus it conveys pricing information quickly and in a reliable manner. As the store of value money retains some of its value over the period for which it is held, thus its key attribute is its ability to store purchasing power. Depending on the function for which the substitution takes place, the literature identifies three different types of euroization: financial, real and payment euroization (De Nicolo et al., 2005).

Financial Euroization

Financial euroization or asset substitution takes place when assets denominated in foreign currency are held as store of value. Calvo and Veigh (1992, p.4) argue that the euroization process begins with substitution taking place in the store of value function since this is considered the most vulnerable function in inflationary periods. Up until the Asian Crisis in the late 1990s, the literature on financial euroization was focused only on asset substitution i.e. the use of foreign currency as store of value.

Only afterwards, economists started paying attention to the liability side of the balance sheet and started researching the holding of foreign currency financial liabilities. Financial euroization, as used in the literature in these past few years, is defined, by Ize and Levy Yeyati (2003), as the holding of assets and liabilities in foreign currency. Financial euroization in terms of balance sheets of households and firms, and banks is presented in Figure 2.1 presented below.

Figure 2.1 Balance sheets in terms of financial euroization



As seen above, within households' or firms' balance sheets, asset euroization refers to their holding of deposits in foreign currency, and liability euroization refers to their obtained loans in foreign currency. However, the opposite holds with regard to banks' balance sheets: asset euroization refers to banks' lending in foreign currency and liability euroization refers to banks raising deposits in foreign currency.

The literature during the last decade treats deposit euroization (DE) as the propensity of households, enterprises, and even governments to hold deposits in foreign currency, and credit euroization (CE) as the propensity of commercial banks to approve loans in foreign currency (Ivanov, et al., 2011). A specific dimension of credit euroization commonly found in TEs is index linked (or indexed) lending i.e. loans extended in domestic currency but indexed to a foreign currency. Indexed loans seem to represent a combined type of euroization where the unit of account is in the domestic currency but the store of value is in the foreign currency. However, indexed lending is usually ignored in the literature. Most studies do not account for the differences between loans approved in foreign currency and those indexed to it, most likely due to data limitations. Given that the issue is not usually discussed, it is not clear whether indexed loans are ignored or regarded as loans in foreign currency.

Another particular form of financial euroization, known as the "original sin" (Eichengreen and Hausmann, 1999) occurs when governments borrow in foreign currency or indexed to foreign currency, because they are unable to borrow in domestic currency given the currency's weaknesses. However, this concept is beyond the scope of this thesis and will not be pursued further.

Arguably, given the main aim of the thesis, which is to explore to role of euroization in the context of bank efficiency in TEs, financial euroization is the main concern of the thesis. Therefore, when we refer to 'euroization', we are referring to financial euroization in this thesis unless specified differently. Given that the remaining types might play a substantial role in the risks related to the main relationship between euroization and bank efficiency, they are also defined in the following subsections.

Payment Euroization

Payment Euroization takes place when foreign currency substitutes the domestic currency as a medium of exchange. By choosing foreign currency instead of domestic one as the means of payment, economic agents trade off the purchasing power risk of the domestic currency with the transaction costs of using the foreign currency (Engineer 2000). Thus, they will prefer foreign currency if the expected depreciation of the domestic currency is high, and the transaction costs such as conversion costs are low (Brown and Stix, 2014). Initially most of the literature on Euroization was focused only on foreign currency replacing domestic one as means of payment and is known as currency substitution literature.

Real Euroization

Real euroization takes place when the foreign currency substitutes the domestic currency as the unit of account; that is domestic prices and wages are set in the foreign currency. According to Calvo and Veigh (1992) real euroization occurs after financial euroization. They argue that after the substitution of the store of value function has taken place, in the presence of high inflation prices of goods begin to be quoted in foreign currency, then finally larger transactions start to be performed in the foreign currency. However, Ize and Parrado (2006) documented that real euroization is moderate in countries that have high financial euroization. The

literature on real euroization is rather limited, which is probably due to the fact that direct measurements of real euroization are rather scarce.

2.3 The origins of Euroization

Euroization, in terms of this thesis, has a long history and deep roots, which can be traced back to early 1900s in the Latin American countries. (In these countries it is known as dollarization, given the major currency involved, and in what follows in the rest of this section we follow the literature and use that term, but as discussed in section 2.2 elsewhere in the thesis we use the term euroization.) As a phenomenon dollarization received a push when the convertibility to gold was abandoned in early 1930s and by 1970s it became important in the region when the foreign exchange controls in financial and currency markets were eliminated. Between the end of the Second World War and the 1970s the international monetary system followed the Bretton Woods system, which established that countries had to maintain fixed exchange rates against the US Dollar. The underlying idea was that by gradually adjusting the nominal exchange rate over time they could achieve a lower the level of inflation. The widespread support at this time for the fixed exchange rate system was reflected in the Latin American region as well, which at the time was struggling with very high inflation and great macroeconomic instability.

Unfortunately, the fixed exchange rate systems was not the answer for the Latin American countries, given that the inflation rate did not fall and many countries in the region experienced massive real currency appreciations and increasing current deficits in late 1970s and early 1980s. Different countries attempted various solutions to the crisis, although most of them implemented several waves of financial sector reform (Corbo and Fischer 1995). A sequence of government interventions, involving capital and foreign exchange controls that were first introduced, then abandoned and subsequently reintroduced, were employed in the 1970s and 1980s in many Latin American countries (Savastano, 1996). Mexico lifted its foreign exchange controls in 1977, reinstituted them in 1982 and then lifted them again in 1985. Bolivia lifted its foreign exchange controls in 1973, reinstituted them in 1982 and then lifted them in 1986. Peru lifted its foreign exchange controls in 1985, reinstituted them in 1986 and lifted them again in 1988 (Gomis-Porqueras, et al., 2000). As capital and foreign exchange controls were lifted the foreign currency began to replace the local

currencies, starting the process later known as dollarisation. The individuals and households of these countries used dollarisation to protect their assets from the high inflation and macroeconomic instability that was characterizing these countries at the time. The degree of dollarisation grew steadily from the time when restrictions were eased until they were reinstated. Therefore, the process was fuelled by the financial reforms of the 1970s employed in the Latin American region.

The struggle of the Latin American region with macroeconomic instability and the external debt crisis in the 1980s, combined with the failed government interventions, resulted in higher inflation rates, larger deficits, deeper external imbalances and continuous capital flight accelerating the process of dollarization (Quispe-Agnoli, 2002). In the 1990s government policies in Latin American countries shifted dramatically from policies based on government intervention to market-oriented reforms which sought to control inflation and achieve economic stability by fiscal discipline, reduction in the size of the government, privatization, tax reform, and trade and financial liberalization (Quispe-Agnoli, 2002). Nevertheless, although the macroeconomic stability was achieved, the degree of dollarisation remained high in the region. As discussed in section 1.4 a similar process occurred few decades later in European Transition economies with the citizens and firms in these countries substituting the Deutch Mark (and then Euro) for the domestic currency.

2.4 Development of Euroization

Euroization has been investigated in the literature from different perspectives. The early literature focused on payment euroization, therefore it is known as currency substitution view. The recent literature has focused more on financial euroization and is divided into three separate strands. In the subsequent sections, we provide a critical analysis of these views.

2.4.1 The early literature

The early literature, also known as **c**urrency substitution approach maintains that euroization is consequence of macroeconomic instability combined with high rates of inflation and exchange rate instability. Therefore, the focus is on the relationship between the degree of euroization and the level of the inflation and the link between

euroization and monetary policy ineffectiveness. This approach maintains that economic agents consider euroization because they perceive domestic currency as less credible in the presence of high inflation (Balino et al., 1999; Court et al., 2010); thus, the demand for domestic currency is negatively correlated with the country's inflation rate (Savastano, 1996). This is in line with the developments taking place in the early phase of transition discussed in section 1.4. During the 1990s, TEs experienced repeated episodes of high inflation and hyperinflation that decreased the credibility of domestic currencies and incentivized people to euroize.

In terms of its impact on the economy or its consequences, the currency substitution approach argues that euroization leads to a less effective monetary policy since the money demand for domestic currency becomes more unstable in the presence of euroization (Balino et al., 1999). Euroized economies tend to show signs of a more unstable demand for money and a more elastic price response to monetary shocks, as the currency composition of liquid balances becomes more sensitive to devaluation expectations (Levy Yeyati, 2006). Under currency substitution, the central bank is considered to be less able to influence the relevant interest rates for consumption and investment decisions (Galindo and Leiderman, 2006). Finally, the approach argues that once the rate of inflation (or inflationary expectations) decreases and reaches certain stability, euroization ceases to increase. Then, eventually economic agents will orientate their preference towards the domestic currency, thus with time euroization should recede (Levy Yeyati and Sturzenegger, 2001).

The main challenge to this approach is hysteresis or the persistence of euroization, which has taken place in developing countries. Although, the approach argues that with time euroization should recede, as discussed in section 1.3, the level of euroization has remained high in most of TEs during the last two decades. The persistence of euroization has attracted attention in the literature, becoming a focus of various studies. A theoretical argument for hysteresis is that the high levels of inflation encourage the development of new financial instruments (a gradual and costly process) which economic agents continue to use even after inflation is reduced (Dornbusch and Reynoso, 1989; Wolf, 1990 in Calvo and Veigh, 1992). The inability of the currency substitution approach to fully explain the hysteresis of euroization has oriented the recent literature towards financial euroization, which is the focus of the recent literature.

2.4.2 The recent literature

The more recent literature has mainly explored financial euroization. This literature is divided into three strands: the portfolio view, the market failure view, and the institutional view.

Portfolio view

The portfolio approach focuses on explaining the preference for foreign currency as the store of value. The approach was put forward by Ize and Levy Yeyati (2003) and considers the level of euroization as an optimal portfolio choice for a given distribution of real returns to the assets in domestic and foreign currencies. This approach argues that the returns of real cash flow of assets in domestic and foreign currencies are uncertain because of inflation and exchange rate volatility (Ize and Levy Yeyati, 2003; Basso et al., 2011). Thus contrary to the currency substitution view, this approach argues that incentives for euroization centre on volatilities of inflation and the exchange rate instead of their levels. The underlying assumption of the portfolio approach is that if the uncovered interest rate parity holds, the emphasis is placed on the variances (Ivanov et al., 2011). The idea is that the higher the variability of inflation relative to real exchange rate depreciation the riskier and less attractive the domestic currency assets. Therefore, a stable domestic inflation and volatile exchange rate should increase the preference for the domestic currency as store of value and thus reduce financial euroization (Rennhack and Nozaki, 2006 p.6).

The portfolio approach argues that policies that target exchange rate stability induce financial euroization. Thus, although many TEs switched to exchange rate targeting and aimed at exchange rate stability to remove the macroeconomic imbalances that introduced euroization in the first place, the exchange rate stability can induce the persistence of euroization. Exchange rate stability remained a policy objective for many TEs mostly because of the major difficulties any depreciation would cause due to the existing high levels of euroization. This is, what Calvo and Reinhart (2002) referred to as "fear of floating" i.e. the interventions of central banks to "avoid sudden or large depreciation although exchange rate regime is flexible" (Levy Yeyati and Sturzenegger, 2007, p.3). The portfolio approach thus argues that instead of exchange

rate stability countries should use a combination of floating exchange rates and inflation targeting to reduce euroization incentives (Levy Yeyati, 2006).

The portfolio approach is criticized on grounds of its underlying assumptions that interest rate parity holds. By assuming this, the theory excludes the possibility of a risk premium or an interest rate differential being potential cause of euroization.

Market failure view

The market failure view considers financial euroization a consequence of market imperfections and externalities and an inadequate regulatory framework that fails to address these problems (Levi Yeyati, 2006). The argument is that a series of market imperfections can distort the choice of currency composition, subsequently leading to euroization. A possible market imperfection that could induce financial euroization is "currency-blind" policies or regulations that do not differentiate between domestic and foreign currency (Broda and Levy Yeyati, 2006). In situations when the deposit insurance policy or lender of last resort policy are currency-blind, economic agents expect that government will provide a bail out irrespective of the currency in which their assets or liabilities are denominated. Consequently, they will attempt to benefit from the stability the foreign currency provides, in spite of the associated risks (De Nicolo et al., 2005) thus, they will behave recklessly rather than hedge and have the tendency to euroize. For instance, if the foreign currency is perceived as the most stable currency households will prefer to deposit their money in the foreign currency. Banks, faced with a higher supply of deposits in foreign currency, will lower interest rates on deposits in foreign currency compared to those in domestic currency. Given that now they have substantial liabilities in the foreign currency, they will attempt to hedge against currency risk by lending in foreign currency proportional to their foreign currency liabilities. The lower interest rates on foreign currency means that the funding costs in foreign currency are lower compared to those in domestic currency.

In addition, the high degree of foreign ownership within banking sectors in TEs means that most of the banks in these countries are able to raise faster and cheaper additional funds in foreign currency through their ties with foreign banking groups or parent banks. Consequently, banks are incentivized to lend in the foreign currency.

Additionally, if they believe that the government will bail them out in case of large depreciation they will continue to lend in foreign currency without paying enough attention to the associated risks. The currency-blind regulations can also induce euroization because in situations of bank liquidation banks do not pay the higher costs of foreign currency deposits in the event of default and thus find it cheaper to finance their project through foreign currency funding (Broda and Levy Yeyati, 2006, p. 970). The currency-blind regulatory framework also incentivizes households to euroize i.e. hold deposits in foreign currency. For instance, if they believe that their deposits are safe given that the government provides the necessary security by bailing out banks, they will prefer holding their deposits in the foreign currency and thus benefit from its perceived stability. In addition, in the event of bank liquidation due to the depreciation of the domestic currency the domestic currency depositors are discriminated against, since the foreign currency depositors will have larger claims on the bank's residual values. Consequently, this can lead to a higher level of euroization.

The market failure view is mostly focused on explaining the market failures that encourage the acceleration of the degree of euroization in TEs instead of identifying the failures that introduced the phenomenon of euroization.

Institutional view

The institutional approach maintains that institutional failures and the low quality institutional framework can encourage and enhance euroization. The rationale behind this approach is that a low quality institutional framework can introduce or reinforce market distortions, contributing to the enhancement of euroization (Levy Yeyati, 2006). The approach argues that due to a low quality institutional framework the government's commitment to control inflation is not credible for economic agents such as household and firms. Consequently, given the lack of confidence in both monetary and fiscal policy, because of behaviour in past periods, the rational responses of households and firms will be to increase euroization (Calvo and Guidoti, 1990; Feige, 2003; De Nicolo et al., 2003; Honig, 2005). Faced with low credibility of the other economic policies governments can aim to increase its credibility by euroizing their obligations, also known as the "original sin" (Eichengreen and

Hausmann, 1999), which is considered a "costly way to commit to low inflation" (Levy Yeyati, 2006, p.16).

In addition, this approach argues that low quality institutions, particularly in the banking sector, are more prone to engaging in a government bailout (De Nicolo et al., 2005; Levy Yeyati, 2006). If they are confident that in case of need they will get bailed out and they believe that if needed the central bank can provide foreign exchange liquidity, they tend to be more reckless in hedging foreign exchange risk. Hence, euroization can be considered the "collateral cost of low institutional credibility" (Levy Yeyati, 2006, p. 82).

The main limitation of this approach is that it significantly overlaps with the other approaches in its underlying assumptions. It only highlights the role of low quality institutions in inducing euroization through the channels already identified by the previous approaches. In addition, the institutional approach, as Weymoth (2007) points out, argues that low quality institutions encourage euroization but fails to identify which institutions are more important and why. Weymoth (2007, p. 14) attempts to overcome this limitation by identifying "good" institutions that deter euroization. According to him, institutions that enhance the protection of private property actually deter euroization. In addition, the approach does not recognize institutions related to financial sector itself as potential drivers of euroization.

To sum up as explained above the existing theoretical approaches tackle euroization from different aspects. The existence of various types of euroization has led to different theoretical approaches. Consequently, studies usually focus on the most relevant type depending on the context of the research. Given that throughout the thesis the focus will be on financial euroization the recent theoretical approaches are more relevant.

2.5 The advantages and disadvantages of euroization

This section further explores euroization by breaking down its main advantages and disadvantages derived from the main theoretical approaches.

2.5.1 Advantages

The consensus in the literature is that euroization contributes to macroeconomic stability by removing the problem of high inflation and thus solving the credibility problem. In general, high inflation contributes to the shallowness of the financial system. It raises banks' screening and monitoring costs, thus, banks lend and allocate less capital, limiting financing of the economy and induces savers to save less, preferring physical assets instead of financial ones (Court et al., 2010). Euroization reduces inflation by reducing currency risk and foreign exchange transaction costs (Alesina and Barro, 2002; Frankel and Rose, 2002; De Nicolo et al., 2005) solving the credibility problem that arises when a domestic central bank is unable to keep the rate of inflation low (Winkler et al., 2004). This consequently reduces the transaction costs for international trade, especially with the country of the foreign currency, which leads to greater economic integration (Frankel and Rose, 1998; Rose and Engel 2000a; Winkler et al., 2004). Considering that the issuing country tends to be more developed, euroization can lead to greater integration with global financial markets (Click, 2007), which is usually beneficial. Furthermore, greater integration with global financial markets means greater domestic intermediation due to the increased capital flow (Komarek and Melecky, 2003) and higher financial sophistication. It also means greater financial depth (De Nicolo et al., 2005). The magnitude/significance of all the advantages mentioned above depends on the degree of euroization.

2.5.2 Disadvantages

The most discussed disadvantages of euroization are the loss of seigniorage, loss of a lender of last resort and the loss of the use of monetary policy (Winkler et al., 2004; Click, 2007; Honohan, 2007). The loss of seigniorage revenues from issuing a domestic currency is a direct substantial cost of euroization. The loss of a lender of last resort – ability to inject the necessary liquidity to prevent a default on deposits (Berg and Borensztein, 2000) or liquidity risk - is a substantial risk particularly in times of banking sector crises. The presence of euroization also weakens, if not eliminates, the use of monetary policy as a hedging instrument against asymmetric shocks. Therefore, given the important role of monetary policy in accommodating asymmetric shocks and stabilizing business cycles, euroization can lead to higher macroeconomic instability (Schmitt-Grohe and Uribe, 2001). As with the advantages,

the magnitude of the disadvantages depends on the degree of euroization. Another substantial disadvantage of euroization is the increased vulnerability of the banking sector (Honohan and Shi, 2002). Significant deposit euroization induces credit euroization as a hedging mechanism against currency risk. Nevertheless, this is not a foolproof hedging strategy given that households and non-exporting firms receive their income in the domestic currency but now their debt is may be denominated in the foreign currency. By crediting these agents in foreign currency, banks have passed the foreign exchange risk to them. However, given their inability to hedge their currency positions this risk is partly transformed into default risk. This is what is referred in the literature as currency mismatch risk (De Nicolo et al., 2005). In the worst case scenario a large number of firms and household will not be able to repay the debt, which will lead to widespread bankruptcy. Thus, euroization can also increase systemic risk. Higher euroization can also reduce the effectiveness of financial safety nets, raise foreign currency demand, and accelerate a currency crisis, thereby further worsen the solvency of banks (Jacome, 2004). The currency mismatch risk is the basis of the negative impact of euroization on banking sector performance and financial stability (Dornbusch, 1998; Krugman, 1999; Studart, 2001; Calvo et al., 2003 in Galindo and Leiderman, 2006). Another serious consequence of euroization is the exacerbation the country risk when banking crises are combined with currency crises (Druck et al., 2001; Gruben and Welch, 1996; Honig, 2009).

2.6 Empirical review

Euroization has been researched extensively empirically with regard to its determinants and its impact on the economy and financial sector. However, depending on the type of euroization examined and how it was measured, the results differ significantly. In line with the theoretical literature, most of the early empirical literature was focused on the determinants of euroization; scholars were interested on defining the driving force behind euroization. It was later that the possible impact of euroization on the economy and financial sector generated interest. The first part of this section will discuss the issues regarding the measurement of euroization, depending on the type of the euroization used. The discussion of the measurement issues will be followed by a review of the studies that have investigated the determinants of the euroization. In the last part the main studies that have

researched the the relationship between euroization and banking sector will be analysed.

2.6.1 Measurement of euroization

Studies of euroization are bound to have measurement issues mainly due to different types of euroization but also due to unavailability of data. In the presence of various types of euroization there is lack of consistency in choosing an indicator of euroization, thus most of the studies address only one aspect of euroization (Levy Yeyati, 2006). Nevertheless, even if the issue of the precise definition of the euroization is dealt with and an ideal measure of euroization is agreed upon (which would include the measurement of currency substitution in all major functions of the money) there is the problem of the unavailability and reliability of the data. Every empirical investigation on euroization is faced with the obstacle of the unavailability of reliable data and forced to use imperfect measures, regardless of whether it is investigating transition or industrial economies.

As explained in section 2.1 most of the early literature explored currency substitution, that is payment euroization. Nevertheless, given that as discussed above "there is usually no data available on foreign currency circulating in an economy" Calvo and Vegh (1992, p.21) empirical literature sidestepped this issue by using the share of foreign currency deposits in total deposits. Therefore, this part of the literature has problems (Ize and Levy Yeyati, 2003) given that it explains the determinants of payment euroization based on the currency substitution theoretical framework, whilst using a measure of financial euroization. Using different types of euroization interchangeably can be misleading since both determinants and conceptual implications of the two phenomena are rather different (Sahay and Veigh, 1995). The empirical literature on real euroization is rather limited; mostly due to the fact that the direct measurement of real euroization is scarce. Due to these limitations, the literature is oriented towards financial euroization, which faces less empirical problems. The literature on financial euroization, until very recently, focused only on deposit euroization. This was first, because data on deposit euroization were the most ready available data. However, most of the studies employed imperfect measures of deposit euroization that exclude the foreign currency deposits held abroad (Savastano, 1996), a limitation which was made clear

in all these studies. Second, most of the studies neglected credit euroization because they believed that deposit and credit euroization mirror each other due to regulatory requirements, which is not necessarily the case as discussed in section 1.3.

As explained before financial euroization is the most applicable type of euroization in the context of this thesis. This is the most straightforward type in terms of measurement issues as well except for the issue of how to treat foreign currency indexed loans[3] (discussed further in section 5.8.4).

2.6.2 Determinants of euroization

This section discusses the literature on the determinants of financial euroization, setting the scene for the thesis and feeding through to the discussion in Chapter 6. It starts with a concise summary of the main drivers of deposit euroization in relation to the existing theoretical approaches. Although we have argued that credit euroization is not simply a mirror of deposit euroization, many of the same factors may affect both through banks' and other agents' decision making. It then continues with a particular focus on the determinants of credit euroization.

The existing empirical literature identifies the following main determinants of deposit euroization:

(i) The **past rates of inflation** especially high and unstable inflation rates, usually captured in the empirical studies by the historic observed inflation rates or volatility of inflation rates, are found to be the most important determinant supporting the currency substitution view (Savastano, 1996; Fischer, et al., 1996; Arteta, 2005; Honig, 2009; Neanidis and Sava, 2009; Neanidis, 2010; Ivanov et al., 2011; Vieria et al., 2012; Tkalec, 2013). Whilst, the observed rates of inflation are found to be important, the expected rates of inflation or the forward-looking aspect is not found of importance in a particular study that employees data from a household survey conducted in CESEE (Sitx, 2009).

[3] Foreign currency indexed loans are loans that are disbursed in the domestic currency but are indexed or linked to a fixed normal exchange rate which is usually set based on a historical average.

(ii) **Macroeconomic conditions** captured by the macro variables such as real GDP growth or interest rate differential, as explained in the following page, are also found to be important determinants (Savastano, 1996; Honohan and Shi, 2002; Ize and Parrado, 2002; Ize and Levy Yeati, 2003; Arteta, 2003; Honohan, 2007; De Nicolo et al., 2005; Scheiber and Stix, 2009; Honig, 2009; Neanidis and Sava, 2009; Neanidis, 2010; Ivanov et al., 2011; Vieria et al., 2012; Tkalec, 2013).

(iii) The minimum variance portfolio **(MVP)** or the trade-off between inflation and real exchange rate variability is also found to be important, supporting the portfolio theoretical view (Ize and Levy Yeyati, 1998; Ize and Levy Yeyati, 2003; De Nicolo et al., 2005; Honig, 2009; Neanidis and Sava, 2009; Basso et al., 2011; Neanidis, 2010; Ivanov et al., 2011; Vieria et al., 2012; Tkalec, 2013).

(iv) **Regulatory framework,** consisting of bank safety nets, insurance schemes and the presence of last resort, which does not discriminate between domestic and foreign currencies i.e., does not differentiate in terms of regulatory requirements between domestic and other currencies**,** is found to be a driver, supporting the market failure view (Broda and Levy Yeyati, 2006). The regulatory framework is usually controlled for in the empirical studies through indicator variables which would differentiate between countries that have different regulatory requirements between assets and liabilities in foreign and domestic currency.

(v) **Institutional quality** is another identified determinant, particularly of the speed of its development, supporting the institutional quality approach (Savastano, 1996; Ize and Levy Yeyati, 2003; De Nicolo et al., 2005; Seater, 2008; and Neanidis and Sava, 2009). Empirical studies usually use the EBRD's Banking Sector Reform Index, which is explained in detail in section 1.4 as a proxy for institutional quality.

As mentioned, credit euroization is the less explored side of the financial euroization, which only recently has been given attention in the literature. Deposit euroization has been studied considerably more, also because it was investigated in the context of currency substitution. The lack of literature on credit euroization has been mainly

attributed to the lack of an overall theoretical framework (Basso et al., 2011). The existing theoretical approach does not provide a clear explanation for the presence of both credit and deposit euroization. The portfolio approach can explain why households hold deposits in foreign currency but not why they are borrowing in foreign currency. In addition, the lack of data has constrained the existing literature to focusing mostly on deposit euroization or credit euroization but typically not both (De Nicolo et al., 2005). The use of only one of them was considered a reasonable choice given that it was thought that both credit and deposit euroization often mirror each other due to prudential regulations in many countries (Levy Yeyati, 2004). Nevertheless, it turns out that credit and deposit euroization do not always match and often display different patterns (Ize and Levy Yeyati, 1998; Catao and Terrones, 2000; and Basso et al., 2011). This triggered a new wave of empirical investigations that focused on the determinants of credit euroization either on its own or in comparison to deposit euroization.

The empirical literature takes into account determinants that reflect: the supply side (such as foreign currency deposits, foreign ownership); the demand side (interest rate differentials); and both sides (inflation volatility, exchange rate volatility, MVP). It identifies the following main determinants of credit euroization:

(i) **Interest rate differentials** (between the foreign and local currency), measured as the difference between the interest rate in the foreign currency loans and the one in the local currency, are found one of the most significant determinants (Barajas and Morales, 2003; Arteta, 2005; Basso et al., 2011; Luca and Petrova, 2008; Neanidis and Sava, 2009; Rosenberg and Tirpak, 2008; Zettelmeyer et al., 2010; Brzoza-Brzezina et al, 2010; Neanidis, 2010; Brown et al., 2011; Haiss and Rainer, 2012; Ivanov et al., 2011; Basso et al., 2011; Brown and De Haas, 2012). The differential, besides the relative price of foreign currency loans, reflects the macroeconomic stability and its significance depends upon the trade-off effect between the currency risk and real interest rate risk if the inflation is lower than expected (Cuaresma et al., 2013; Hake et al., 2014).

(ii) **Bank currency matching,** which entails matching of foreign currency positions/hedging against exchange rate risk by lending in foreign currency is

another main factor of euroization. Lending in foreign currency is the only possibility for banks for hedging against currency risk in TEs due the lack of hedging instruments in countries with underdeveloped banking systems and lack of financial markets. Therefore bank currency matching is widely proxied in the empirical studies by the degree of deposit euroization in the country, or the difference between deposit euroization and credit euroization (Luca and Petrova, 2003; Ize and Levy Yeyati, 2003; Basso et al., 2011; Neanidis and Sava, 2009; Haiss et al., 2009; Rosenberg and Tirpak, 2008; Zettelmeyer et al., 2010; Neanidis, 2010; Ivanov et al., 2011; Brown et al., 2011; Brown and De Haas, 2012; Haiss and Rainer, 2012). In terms of bank currency matching, Neanidis and Sava (2009) argue that it drives euroization only in the short run contrary to Ivanov et al. (2011) who find it a long-term determinant.

(iii) **Exchange rate volatility**, usually controlled through the standard deviation of the exchange rates between domestic and foreign currency(Luca and Petrova, 2008; Haiss et al., 2009; Honig, 2009; Rosenberg and Tirpak, 2008; Brown and De Hass, 2012; Neanidis, 2010; Brown et al., 2011; Ivanov et al., 2011) **and MVP** or the trade-off between real exchange rate variability and inflation also have an effect (Ize and Levy Yeyati, 2003; Barajas and Morales, 2003; De Nicolo et al., 2005, Luca and Petrova, 2008; Scheber and Stix, 2009; Neanidis and Sava, 2009; Honig, 2009; Basso et al., 2011; Neanidis, 2010; Ivanov et al., 2011).

(iv) **Access to foreign funds**, usually proxied by the share of foreign bank assets in the banking system**,** also contributes to credit euroization (Luca and Petrova, 2003; Arteta, 2005; Basso et al., 2011; Stix, 2009; Rosenberg and Tirpak, 2008; Neanidis and Sava, 2009; Haiss et al., 2009; Basso et al., 2011; Brown and De Haas, 2012; Haiss and Rainer, 2012).

(v) **Poor institutional quality** and credibility (particularly in the banking sector), usually proxied through the EBRD's Banking Sector Refrom Index is another significant determinant (Ize and Parrado, 2002; Feige, 2003; Jeanne, 2003; Luca and Petrova, 2003; Arteta, 2005; Scheber and Stix, 2009; Stix, 2009; Neanidis and Sava, 2009).

(vi) **Market imperfections** such as limited bank competition, network externalities and transaction costs such as banks' cost structures, tradable collateral capabilities and the cost of loan enforcement, which are usually proxied by the degree of concentration in banking sector or through some measure of law enforcement such as corruption indices, also matter (Catao and Terrones, 2000; Barajas and Morales, 2003; Feige et al., 2004; De Freitas, 2004; Haiss et al., 2009).

Taking into consideration that deposit euroization has been extensively studied in the TEs under consideration whereas credit euroization has been neglected until very recently, this thesis aims to address this gap and explore the credit euroization side of financial euroization whilst analysing the main drivers of drivers of euroization in TEs established theoretically and empirically. The details of the most recent studies that have investigated credit euroization either on its own or together with deposit euroization are presented in Table 2.1.

Table 2.1 Recent empirical investigations of credit euroization in TEs

Author (year)	Methodology	Period	Sample	Data
Only Credit Euroization				
Haiss & Rainer (2012)	FE; RE	1999-2007	13 countries (CESEE)	Firm, Household survey
Brown et al. (2011)	Probit; OLS	2002-2005	9655 firms in 26 countries	Firm survey
Brown & De Haas (2012)	OLS	2005	192 banks in 20 countries	Bank survey
Brzoza-Brzezina et al. (2010)	SUR; VAR	2007-2008	4 countries (CESEE)	Macro-level
Zettelmeyer et al (2010)	GMM	2000-2008 2002-2005	CESEE & CIS	Macro, Firm survey
Rosenberg & Tirpak (2008)	OLS; FE; RE	1999-2008	8 countries (CESEE & CIS)	Macro-level
Haiss et al. (2009)	OLS	1999-2006	16 countries	Macro-level
Berkmen & Cavallo (2010)	GMM	1970-2003	145 countries	Macro-level
Luca & Petrova (2008)	OLS	1990-2003	21 countries (CESEE & CIS)	Macro-level
Rosenberg & Tirpak (2008)	OLS; FE; RE	1999-2007	10 countries (CESEE & CIS)	Macro-level
Both Deposit and Credit Euroization				

Ivanov et al. (2011)	Johanen & Engle-Granger threshold coint.;VECM & threshold VECM	1997-2010	Croatia	Macro-level
Basso et al (2011)	Panel; Panel-VAR	2000-2006	24 countries (CESEE & CIS)	Macro-level
Neanidis (2010)	Feasible generalized least squares (FGLS); 2SLE RE; 2SLE FE	1991-2010	24 countries (CESEE & CIS)	Macro-level
Honig (2009)	OLS; FE; RE	1998-2000	90 countries	Macro-level
Neanidis & Savva (2009)	OLS	1993-2006	11 countries (CESEE & CIS)	Macro-level
Neanidis & Savva (2009)	OLS	1993-2007	9 countries (CESEE & CIS)	Macro-level

As seen above, the vast majority of the recent empirical literature on credit euroization explores the macro level determinants with the exception of few recent papers that use household, firm and bank-level survey data. This thesis will use macro data to explore the determinants of euroization. A common weakness of these studies is their time span: most of them cover the period up to year 2008; thus, do not capture the effects of the global financial crisis. The only exceptions are Neanidis (2010) and Ivanov et al. (2011) which cover the period until year 2010, but given that year 2009 and 2010 are the years in which the effect of the crisis reaches TEs, these studies are also limited in capturing fully the impact of the crisis in these countries. In this regard the thesis extends the empirical literature by covering a period that is less researched, from 2007 up until 2013, which will also enable capturing the effects of the global financial crisis given that it had a delayed effect in some of the TEs particularly the SEE countries. The data is also of wide sample of countries (24). In terms of methodology, only two studies Berkmen and Cavallo (2010) and Zettelmeyer et al. (2010) employ GMM techniques, which are arguably the most appropriate given the need to capture the dynamics of the investigated relationships. The thesis adds to previous research on the determinants of financial euroization in this regard by investigating the use of dynamic panel analysis to differentiate between the short-run and long-run effect of the determinants of euroization and to adjust for the potential endogeneity of conventional determinants.

Finally, none of the studies control for the impact of macroprudential policy instruments, most likely because this policy has been employed more extensively from year 2009 onwards (see section 1.5 for a detailed discussion on this). Given this background knowledge the thesis extend the euroization literature by being the first

study that explores the relationship between macroprudential policy instruments and credit euroization.

2.6.3 Euroization and the financial system

Although the empirical literature on the impact of euroization on financial system performance in the context of TEs has increased during the last decade, it remains rather limited. Euroization, given its significant and persistent presence in TEs, documented in section 1.3, may well have an impact on bank performance; however, the existing literature on determinants of banking efficiency does not recognize it. There are only a handful of studies that explore the relationship between euroization and financial instability, banking crises and other banking performance indicators (De Nicolo et al., 2003; Arteta, 2003; Levy Yeyati, 2006; Shinichi, 2007). However, since the global financial crisis, financial euroization started to receive greater attention in the literature mostly due to its positive role in increasing the systemic risk (Ozsoz 2009; Court et al., 2010; Kutan et al., 2010; Fidrmuc et al., 2013). The global financial crisis showed that the unique characteristics of the financial sector in the region such as financial euroization, constrain policymakers in containing their vulnerabilities and risks when faced with difficulties. Higher financial euroization instead of helping economies recover can deepen or trigger recession (Cook, 2004).

Furthermore, the existing empirical evidence remains inconclusive. Most of the studies find that financial system development is adversely impacted by euroization; however, there are few studies indicating that euroization is beneficial in terms of asset's quality and a few others that find no significant relationship. These findings are summarised in Table 2.2.

Table 2.2 Recent empirical investigations of euroization and financial system

Author (year)	Method.	Sample/ Period	Dependent variable	Independent variables	Findings
Fidrmuc et al. (2013)	Two-stage Heckman selection approach	1000 individuals, in 9 countries /2007-2010	Financial vulnerability (Loan arrears)	Credit euroization (Dummy variable); exchange rate depreciation	It has a positive impact on financial vulnerability in depreciation countries
Kutan et al. (2010)	GMM	5249 banks in 36 countries /1991-2001	Bank profitability (Profit before tax/total assets);	Deposit euroization; GDP; inflation; interest rate spread; LLP/Total loans; equity/total assets;	It could increase financial fragility, create balance sheet problems and affect bank profitability
Court et al. (2010)	OLS	44 countries /1996-2002	Financial Deepening (Credit to the private sector/GDP)	Deposit euroization; Creditor Rights Index; Kauffman Institutional quality index; MVP	It has a negative and persistent impact on bank profitability in dollarized economies
Ozsoz (2009)	OLS; GLS	11 countries /1991-2004	Bank profitability (Profit before tax/total assets); Loan Loss Provisioning	Deposit euroization; Inflation; GDP; net interest income/total assets; overhead expenses/total assets; average lending rate;	No impact on profitability but a strong negative impact on provisions set aside for their loan losses.
Shinichi (2007)	OLS	3 countries /1993-2005	Financial Development (Credit to the private sector/GDP)	Deposit euroization; M2/GDP; Rule of Law Index of Kauffman	It deters financial development through (self-insurance mechanism and remittances)
Levy Yeyati (2006)	Probit;	80 countries /1995-2000	Probability of banking crisis (dummy variable)	Deposit euroization; real exchange rate; interest rate; GDP growth	It positively impacts banking crises and unstable output growth
Arteta (2003)	Probit; OLS; IV regressions	92 countries /1990-1999	Finan.Crisis (Crisis-binary variable; currency-crash-binary variable; GDP growth)	Deposit & credit euroization; FDI/GDP; international reserves; current account balance/GDP; GDP growth; real exch. rate; int. rate;	It increases the probability of currency crises of crashes. It does not find any evidence that crises are more costly with euroization
De Nicolo et al. (2003)	OLS	100 countries /1990-2001	Financial Deepening (Credit to the private sector/GDP)	Deposit euroization; risk measures; formal inflation targeting regimes; institutional variables; dummy regional variables	It seizes to promote financial deepening once inflation stabilizes; and it can increase and financial instability

As seen in Table 2.2 most of these studies explore the relationship using macro or banking sector level data, with the exception of Kutan et al. (2010) and Fidrmuc et al. (2013) who use household and bank level data. The thesis adds to the previous

research by using bank level data. Most importantly, one third of the studies explore the impact of euroization on some measure of financial instability such as banking crisis or deterioration of asset quality, one third investigates the impact on financial deepening, and the remaining third explores the impact on bank profitability. None of the studies explore the relationship between euroization and bank efficiency, which is concerning, particularly given the documented positive impact of the efficient, well-performing banking sectors on economic development (Levine, 1997). The thesis will extend the existing literatue by investigating the impact of euroization on bank efficiency in TEs. Finally, most of studies cover the period up to early 2000, few up to 2005, thus do not capture the years up to, during or after the global financial crisis. The only exception here is the study of Fidrmuc et al. (2013) who cover the period 2007-2010, although their time span is very short to capture adequately any dynamics. The thesis extends the literature by covering an extended period from 2000 until 2013 which enables to capture also any effect of the Global Financial Crisis on the efficiency of banks operating in TEs.

2.7 Conclusions

This chapter has provided a concise critical review of different theoretical approaches explaining the phenomenon of euroization developed in the literature. Initially it defined the concept of interest in this thesis, that of financial euroization. Financial euroization is considered the most applicable euroization pattern in line with the main objectives of the thesis that are to investigate the impact of euroization on bank efficiency, and explore the determinants of euroization. However, given that numerous euroization patterns are inter-related and might have joint as well as individual impact, the chapter explored their presence and considered their potential impact in the light of the different theoretical approaches. It concluded that there is significant overlap between the existing theoretical approaches which tackle euroization from different aspects. Thus, it continued with a breakdown of the advantages and disadvantages of euroization in order to establish the hypothesis with regard to the impact of euroization on bank efficiency.

Subsequently, the chapter established the main drivers of euroization in TEs in the light of different theoretical approaches. The empirical literature review on determinants of financial euroization initially showed that deposit euroization has

been extensively studied in the TEs under consideration whereas credit euroization has been neglected until very recently. It identified a number of potential main determinants of credit euroization, but indicates that macroprudential policy is not taken into account by the existing literature. Given this background knowledge, the thesis aims to address this gap and explore the credit euroization side of financial euroization. It specifically aims to investigate its impact on bank efficiency; analyse its main drivers in TEs, and to establish whether the macroprudential policy has an impact on the level of credit euroization in these countries. These empirical investigations are presented in Chapters 5 and 6.

The literature review shows that the existing theoretical and empirical literature completely neglects the impact of euroization on bank efficiency. Having found no clear suitable theoretical framework for analysing the impact of euroization on bank efficiency in TEs, the chapter sought to explore the literature on the role of euroization in financial system performance. The review showed that the empirical literature on the role of euroization on financial system performance, although it has increased during the last decade, remains limited and inconclusive. There are only a handful of studies that explore this relationship and these are limited in terms of the time span they cover (mostly short and only up to early 2000) and the fact that they completely ignore the aspect of efficiency. This is of concern given the documented positive impact of efficient intermediation on economic development (Levine, 1997). Consequently, a better understanding of the effect of euroization in TEs with underdeveloped domestic financial markets is called for. It is clear that more research is needed in order to understand the euroization phenomenon in the region to undertake appropriate policy actions. To address this gap in the literature, the thesis continues in the next chapter with a concise critical literature review of bank efficiency that will offer the foundation for the empirical investigation presented in Chapter 4.

Chapter 3

Efficiency of the banking sector: A critical review of the literature

3.1 Introduction

Chapter 2 identified the unexplored relationship between bank euroization and bank efficiency and the lack of consensus concerning the impact of financial euroization on bank performance as gaps in the euroization literature that the thesis intends to address. Following on from that, this chapter reviews the literature on bank efficiency. To explore the nature of the impact euroization on bank efficiency in TEs it is necessary to understand how efficiency is measured and what factors affect it. The literature on bank efficiency in TEs is relatively short given that it has only attracted the attention of the researchers in the recent years. Moreover, it is limited given that, to the best of our knowledge, the existing studies have neglected euroization and the

risk-return dimensions. Providing an exhaustive and comprehensive review of the bank efficiency literature is beyond the scope of the thesis. However, this chapter aims to provide a concise, critical review of the main literature on bank efficiency providing a basis upon which the research hypothesis regarding the impact of euroization on a bank's efficiency will be developed. Thus, the chapter will serve as the foundation for the empirical research presented in Chapters 4.

The rest of the chapter is structured in the following manner. Section 3.2 addresses the main definitions and concepts of bank efficiency identified in the literature. A discussion of the measurement of bank efficiency is provided in section 3.3 and is structured in two main parts. The first part considers the traditional financial ratios analysis approach, whereas the second one explains the frontier approach which is then sub-divided into two parts: nonparametric and parametric techniques. Section 3.4 discusses one the main challenges facing the literature on bank efficiency: the definition of the inputs and outputs and control variables. A critical review of this empirical literature is provided in section 3.5. A brief conclusion is offered in the last section.

3.2 Important definitions and concepts

There are various types of efficiency concepts that are not always used consistently in the literature. Broadly speaking, efficiency refers to the comparison between the observed and optimal values of output(s) for a given level of inputs, or vice versa. The bank efficiency literature identifies three main concepts: technical efficiency (TE), allocative efficiency (AE) and economic efficiency (EE). Technical efficiency and allocative efficiency can be defined in different ways. We refer to technical efficiency as the ability of a bank to produce maximum possible output from a fixed set of inputs given the production technology, and allocative efficiency as the bank's ability to optimally combine inputs and outputs, given their respective prices and the production technology.

The definition of economic efficiency, considered in the thesis, is the one used by Farrell (1957), who also was the one of the first scholars to measure efficiency empirically. Farrell argued that TE and AE combined together produce overall

efficiency later referred to in the literature as economic efficiency.[4] A bank is economically efficient if it is able to optimally allocate inputs and outputs, given their prices and production technology (Farrell, 1957; Kumbhakar and Lovell, 2003; Mokhtar et al., 2006). The economic efficiency of banks can be measured in terms of costs or profits (Maudos et al., 2002). Taking into consideration that empirical studies have mostly focused on cost efficiency (Berger and Humphrey, 1997) when investigating bank efficiency, for the purpose of this thesis we focus on cost efficiency. Cost efficiency, specifically, refers to the minimum cost of producing the maximum number of outputs given the prices of inputs and the production technology.

3.3 Methods of estimating efficiency

The importance of measuring bank efficiency is related to the significant impact of bank efficiency on economic development, as discussed in section 1.4. Efficiency measurement has been a longstanding challenge in the banking literature largely due to the complexity of banking activities and the econometric estimation of efficiency. There are two main approaches commonly employed in the literature to measure bank efficiency: financial ratio analysis and frontier efficiency analysis.

3.3.1 Financial ratio analysis

Financial ratio analysis is a popular method of measuring bank efficiency employed by regulatory authorities, potential investors and even banks themselves. This is mainly because it is considered a convenient tool given that ratios are easy to calculate, understand and interpret. Additionally, they are regarded as reliable tools given that they are generally accepted as reflecting the banks' financial performances. Financial ratio analysis consists of numerous indicators that provide important insights to the banks' operations. However, as a tool for measuring bank efficiency it is heavily criticised on the following grounds. Firstly, on the lack of a single universal ratio that would capture the complexity of a bank's efficiency. Secondly, in presence of numerous ratios, there is no consensus on their relative importance in comparison to each other. Thirdly, financial ratios can be heavily distorted by differences in capital structure, accounting practices for reporting reserves and provisions and the

[4] Economic Efficiency in the literature is also referred to as X-efficiency.

range of business and product mix (Vittas, 1991). Thus, the comparability of banks' efficiencies based on ratios is not reliable. Finally, the analysis cannot capture any exogenous factors that affect the ratios themselves (Bauer et al., 1998; Irsova, 2010). This is particularly important in cross-country studies where the efficiency measurement can be misleading if the cross-country differences are not accounted for. Given the focus of this thesis, this is a very strong limitation. On the whole, the financial ratio analysis is not considered an adequate method for the purpose of this thesis; consequently, we turn to the alternative efficiency method: frontier analysis.

3.3.2 Frontier Analysis

Frontier approach, although much more complex, is considered superior to the financial ratio analysis. It conveys the information in a single value, thus enabling the researcher to capture the complexity of banking activity. It also makes the exclusion of the effect of exogenous factors on bank efficiency possible (Bauer et al., 1998). Frontier efficiency analysis relies on the use of the measured costs of inputs, outputs, costs and profits to assign efficiency relative to the best practice. A best practice frontier is initially defined, against which relative efficiencies are then measured. Consequently, the efficiency estimates reflect the degree of proximity of banks to the best practice frontier. Banks that operate on this frontier are considered efficient and those beneath inefficient (Kumbhakar and Lovell, 2003).

Different techniques have been applied in estimating this best practice frontier, which are divided into two main groups: non-parametric and parametric techniques. The techniques differ in their basic underlying assumptions: the shape of the efficient frontier and the distribution of random error (if one is included). The choice between the two techniques has been an issue of debate between researchers and there is no consensus on the best techniques as there are advantages and disadvantages to each. Berger and Humphrey (1997) compare and contrast 130 efficiency studies in 21 countries and conclude that no approach dominates another, since half of them use nonparametric and the other half parametric. They also find that when applied to the same data set the two approaches do not necessarily yield consistent results. To demonstrate the robustness of the results and overcome their individual limitations they advise using both parametric and non-parametric methods with the same data set. Thus, the selection is subject to both theoretical and empirical considerations.

Consequently, the rest of the section provides a critical review of the main literature on both techniques and a careful consideration of Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) as representatives of the two approaches.

Nonparametric techniques

Nonparametric techniques do not to explicitly specify a functional form. Instead, the efficient frontier is derived from the sample observations. Thus, they allow the data to determine the form of the frontier, which makes them simple (Coelli, 2005). The flexibility of the frontier efficiency is their main advantage. However, the approach is extremely sensitive to outlying observations (Aigner and Chu, 1968; Timmer, 1971) and thus can produce misleading information (Mastromarco, 2008). They also do not allow noise to be taken into account in the measurement of efficiency, i.e. they assume that there is no random error and treat all deviations from the frontier as inefficiency. Not allowing for random error is the main limitation of the nonparametric techniques, because any such error is then considered to be a change in measured efficiency, leading to overstated inefficiency estimates (Berger and Humphrey, 1997). They also account only for technical inefficiency of using too many inputs for a specified output or vice versa. Thus, they focus on technological optimization rather than economic optimization (Berger and Mester, 1997). The most commonly used non-parametric technique is the Data Envelopment Analysis (DEA), which is briefly discussed below.

Data Envelopment Analysis (DEA)

The data envelopment analysis (DEA) was developed by Charnes et al. (1978). It is a linear programming technique where "the set of best-practice- the frontier observations - are those for which no other decision-making unit or linear combination of units has as much or more of every output (given inputs) or as little or less of every input (given outputs)" (Berger and Humphrey, 1997, p. 177). DEA constructs an efficiency benchmark of a linear combination of efficient banks with the best combination of inputs and outputs among the observed banks and permits efficiency to vary over time. However, it is extremely sensitive to outliers i.e., extreme observations (Aigner and Chu, 1968; Timmer, 1971). In addition, DEA produces efficiency measures that are point estimates: there is no scope for statistical inference

and therefore it is not possible to construct standard errors and confidence intervals. Another, limitation is that it increases the number of efficient observations by default when there are a small number of observations relative to the number of inputs and outputs, which can lead to overestimation of efficiency (Berger and Mester, 1997).

When first developed the initial underlying assumptions were that all banks face the same technology; they operate at their optimal scale and have constant returns to scale. Constant return to scale is an assumption for which DEA was heavily criticized since banking sector is not characterized by constant returns to scale (McAllister and McManus, 1993; Wheelock and Wilson, 1995). The later versions of DEA take into account variable returns to scale. However, its main limitation that remains is that it does not allow for random error. Consequently, it does not account for any environmental heterogeneity, external shocks, measurement error and omitted variables: the entire deviation from the frontier is considered as inefficiency. This, according to Greene (2005), makes efficiency estimates persistently biased. In the context of this research given that, the aim of the thesis is to capture the impact of euroization as an exogenous factor on bank efficiency this is a very strong limitation. Not accounting for environmental differences is particularly problematic also in cross-country studies (Weill, 2003). Additionally, taking into account that the focus of the thesis is on TEs, where the presence of great uncertainty and measurement problems is considerable (Fries and Taci, 2005).

Recently there were many attempts to develop the DEA further in order to account for the environment. Many studies have introduced the two-step approach in order to control for environment when using DEA. DEA is applied in the first stage to produce efficiency estimates, which are then regressed against a set of environmental variables using OLS or TOBIT. However, the approach has been criticized on the basis that the second-stage regression parameters are biased due to unknown serial correlation among the estimated efficiencies (Simar and Wilson, 2007). Recent studies (Fried et al., 2002; Lee, 2008; Gorman and Ruggiero, 2008) have further developed the approach and have introduced the three-step DEA in order to control for the environmental and statistical noise. According to the Fried et al. (2002) approach, DEA is applied in the first stage to produce the initial efficiency estimates. Subsequently in the second stage, Stochastic Frontier Analysis (SFA) is employed to regress the measures from the first stage against a set of environmental variables.

Finally, in the last stage, either outputs or inputs are adjusted to account for the impact of the environment and the statistical noise and DEA is applied to re-estimate efficiency. This way the variation in efficiency is decomposed into three parts due to: environmental effect; managerial inefficiency; and statistical noise. Nevertheless, the major criticism of biasedness present in the previous two step version still applies. In addition, these extended versions can be considered a stochastic version of DEA given that the SFA is integrated as part of the method.

In conclusion, taking into account that the focus of the thesis is on the impact of environmental and bank individual factors such as financial euroization and bank risks on bank efficiency rather than estimation of efficiency, the use of the non-parametric techniques such as DEA cannot be justified; thus we turn to the second category: parametric techniques.

Parametric techniques

Parametric techniques, contrary to nonparametric ones, define a priori the functional form of the efficient frontier. They are further-divided into deterministic and stochastic models. The deterministic models identify the distance between the observed and the optimal (defined by the frontier and the available technology) as inefficiency (Murillo-Zamorano and Vega-Cervera, 2001). The stochastic models make a distinction between efficiency and statistical noise. They estimate a frontier and decompose the stochastic term of the regression model into an inefficiency component and a random error component (Bonin, 2004). They define a specific functional form for the best frontier and for the error term. Their main advantage is that they allow for noise in the measurement of efficiency. The main limitation of parametric techniques is that the a priori specified functional form for the efficiency frontier does not necessarily fit the data perfectly (Bauer et al., 1998). Stochastic Frontier Approach (SFA) is the most commonly used methods under the parametric approach in the estimation of bank efficiency and is briefly discussed below.

Stochastic Frontier Approach (SFA)

SFA was developed by Aigner et al. (1977) and Meeusen and van den Broeck (1977). The original model was a fully parametric model that assumed a specific functional form for the deterministic frontier and specific distributions for noise and technical

inefficiency. Since then, the model has been extended in various ways. First, there are alternative distributional assumptions about the noise and the inefficiency component (Amsler et al., 2009). Then, the model can be applied to different types of frontiers such as cost and profit, and it can be carried out through systems of equations. Finally, the model has been extended to use panel data, allowing for exogenous variables in both the production function and the efficiency term (Berger and Humphrey, 1997; Mastromarco, 2008; Amsler et al., 2009).

The main advantage of the SFA is that it allows for a random error term. By doing so SFA accounts for measurement errors and exogenous shocks, and arguably provides more accurate efficiency scores. However, this creates a new problem: the separation of inefficiency from the random error term. Another advantage is that SFA allows control of the influence of environmental variables or bank level variables on the structure of efficiency frontier (Weill, 2003). The control variables in SFA can be incorporated in the main function or can be modelled in the error term. In the context of the thesis this is a very strong advantage. In addition, Eisenbeis et al. (1999) find a strong association between inefficiency estimates and risk taking when using SFA, suggesting that when focusing on bank risk one should give relatively more weight to the SFA results. Given that the risk-return aspect is a major part of this research, this is another crucial advantage. In addition, SFA, contrary to DEA, allows the possibility of making inference about the contribution of inputs (Pereira and Moreira, 2007). Finally, SFA has the advantage that is more robust to outliers than DEA and it performs well in small and noisy samples. Therefore, given that in TEs measurement errors in banking data are widespread, SFA is considered a more suitable empirical tool for analysing bank efficiency (Fries and Taci, 2005) and consequently it is often chosen by studies focused on TEs. Given these arguments, the SFA approach is employed in this thesis.

3.4 Definitions of inputs and outputs

In order for a model of measurement or estimation of bank efficiency to be developed: the outputs and inputs of the bank must be clearly defined. Whilst this is straightforward in most industries, it is one of the most debated topics in banking. The controversy regarding the lack of agreement concerning appropriate measures of outputs and inputs (Berger and Humphrey, 1992) is mainly due to the role and nature

of banks. Banks employ multiple inputs simultaneously to produce multiple outputs, thus modelling banking production requires simplification of both.

Studies on bank efficiency usually specify different combinations of inputs and outputs (Sturm and Williams, 2010) depending on the theoretical model of the banking firm and the concept of optimization. Taking into consideration that efficiency estimates are sensitive to the specification of inputs and potential outputs (Berger et al., 1993; Berger and Humphrey, 1997) the comparability of studies on bank efficiency has been questioned. The two main approaches followed are the intermediation approach (asset approach) and the production approach (or value added approach).

3.4.1 The intermediation approach

The intermediation approach, proposed by Sealey and Lindley (1977), maintains that banks intermediate between savers and investors. The approach considers the bank production process as a multistage production process where deposits together with capital, labour and material inputs are transformed into earning assets. Thus, banks inputs such as deposits, labour and capital are employed to produce bank outputs such as loans and off balance sheet items. Deposits and their cost are considered inputs since they constitute the raw material to be transformed into loans and investible funds. Besides production expenses, the intermediation approach also takes into account interest expenses, therefore it is often considered appropriate for investigating economic viability (Avkiran, 2006). In addition, it maintains that risk must be taken into account when modelling bank production (Hughes and Mester, 2008). Although, the risk aspect is still not explored fully empirically (Chelo and Manlagnit, 2011). The intermediation approach has become the dominant approach in estimating bank efficiency (Berger and Humphrey, 1997).

3.4.2 The production approach

The production approach maintains that the main role of banks is producing services for account holders. Under this approach, banks employ inputs such as labour and capital to produce outputs such as loans and deposits. Deposits are considered output because they involve the creation of value added associated with liquidity,

safekeeping and payments services provided for the depositors. It argues that banks perform transactions for customers therefore the output is measured by the number and type of transactions over a given time period. However, such data is not usually available thus the number of deposit or loan accounts serviced is used instead (Berger and Humphrey, 1997). Inputs consist of physical inputs such as labour and capital together with their respective costs. The production approach does not address the non-traditional bank activities, and the associated increased risk aspect in bank production (Hughes and Mester, 2008), although they have become increasingly important in the banking industry (Guarda et al., 2013). Considering that their impact on bank efficiency estimates has been demonstrated in the literature (Casu and Girardone, 2006; Lozano-Vivas and Pasiouras, 2010), the production approach does not fully capture the role of banks.

According to Berger and Humphrey (1997) neither of these two approaches is perfect because they cannot fully capture the role of banks. They argue that the production approach may be more adequate for evaluating the efficiencies of bank branches, whereas the intermediation approach may be more appropriate for banks as a whole. Consequently, the intermediation approach is the one favoured in the literature (Fethi and Pasiouras, 2010). Taking into consideration this and the fact that bank risk-return aspect is an important dimension of this thesis the intermediation approach will be followed.

3.4.3 Control variables

The assessment of the bank efficiency through exclusively the input-output approach is limited since it assumes that every bank operates under the same conditions and therefore it is not influenced by the economic environment. By not allowing for exogenous factors, the approach assumes that any difference in efficiency across banks is the result of management strategy regarding the scale and mix of inputs. This is an unrealistic assumption, particularly in the cross-country investigations given that banks' abilities to perform efficiently depend at least in part on the environment in which they operate. This is particularly important in TEs given the dynamics of their banking and economic development during the transition process in the last two decades. Ignoring the impact of the environment in studies using common frontier approach makes efficiency estimates persistently biased and unreliable (Greene,

2005). Therefore, to make the common frontier meaningful in cross-country investigations, studies need to account for the environment.

Accounting for the environment is possible in the following three ways through SFA. The first way, is to capture the impact of the environment though statistical associations of efficiency estimates and particular control variables. The second way is through the two-step approach, in which efficiency estimates are obtained in the first step through SFA, and then regressed against a set of control variables. However, in this approach the persistent bias of not accounting for the environment in the first step) is carried forward into the second step (Greene, 2005). In order to obtain unbiased efficiency estimates the impact of the environment needs to be incorporated directly in the efficiency estimates. This is done in the third way also known as the single-step approach in which the control variables are incorporated directly in the model. For more on this discussion see section 4.2.3.

To allow for the effect of the environment on bank efficiency several sets of control variables need to be considered. The impact of country features is captured by several country level variables in the bank efficiency estimation. In this context, studies usually include variables such as GDP per capita, GDP growth; level of nominal interest rates and legal and regulatory framework to allow for the level of efficiency to vary systematically across countries (Fries and Taci, 2005). Another set of variables that may affect banking efficiency and that the literature control for are variables that characterise the structure of the banking industry. These are variables such as the degree of market concentration, the share of majority foreign–owned banks and the intermediation ratio, that allow for the effect of the features of banking sector on efficiency (Grigorian and Manole, 2006). The third set of variables consists of bank specific variables that capture the impact of specific bank characteristics. These are variables such as bank size, ownership, profitability and capitalization (Casu and Molyneux, 2003; Casu and Girardone, 2006).

Euroization

An important economic and banking sector's characteristic of TEs is the high degree of euroization. The review of the existing literature on the impact of financial

euroization on the financial sector of TEs, presented in section 2.5.3, leans toward a negative impact of euroization on the financial sector's performance. Euroization is considered a source of fragility for the financial system due to the currency mismatch risk (De Nicolo et al., 2005) which can lead to widespread bankruptcy if it happens on a wide scale and, thus, increase systemic risk. Taking into consideration the above it is reasonable to assume a possible link between financial euroization and bank efficiency in these countries. Yet, researchers have not empirically examined whether and how financial euroization interacts with efficiency at sector or individual bank level. None of the bank efficiency studies acknowledges the effect of the share of euroization on bank's balance sheet or the risks that can arise from them. This can have important policy implications as euroization may have a direct or indirect impact on bank efficiency and risk-return aspect in TEs. To the best of the author's knowledge, this is the first study that considers the relationship between financial euroization bank efficiency and risk.

Risk-returns

Banks are constantly engaged in assessment, monitoring, and diversification of a variety of risks. Thus, risk plays a prominent role in banks' operations. Hughes and Mester (1993), Mester (1996), Berger and De Young (1997) and Kwan and Eisenbeis (1997) argue that it is crucial to explicitly account for banks' risk when investigating bank efficiency. However, traditional bank efficiency models do not take into account the risk-return aspect; "they assume that banks are risk neutral and ignore risk-taking" (Sun and Chang, 2011, p.1728). Hughes and Mester (1993) argue that this is partly due to difficulties in finding good measures of different types of risks and difficulties in deciding which of the many types should be incorporated when estimating efficiency. But not controlling for risk might lead to biased efficiency estimates. According to Mester (1996) banks that are more risk-averse might be mislabelled as inefficient, whilst others that are (excessive) risk-takers might be mislabelled as efficient, since generally higher returns are associated with the taking of higher risks. Research on the relationship between risk and bank efficiency in developed economies is extensive but as Haselmman and Wachtel (2007) point out this relationship is still not well explored empirically in TEs. The limited research on bank efficiency and risk-returns in TEs is somewhat surprising given the importance

of the banking sector and its impact on economic development discussed in the introductory chapter. This is particularly the case as banks' behaviour varies under different institutional settings (Haselmann and Wachtel, 2007) thus it is safe to assume that research findings focused on developed economies may not be applicable to transition countries.

3.5 Review of the empirical literature

The literature on bank efficiency is rich although the vast majority has focused on the banking sector of United States (Berger and Humphrey, 1991; Mester, 1996; Berger and Mester, 1997; Berger and De Young, 1997; Hughes and Mester, 1998; Eisenbeis et al., 1999). Studies of banking sectors in Europe attracted the attention of researchers only later and, although still growing, it is smaller than that focused on US (Altunbas et al., 2001; Pastor, 2002; Girardone et al., 2009; Fries and Taci 2005; Fiordelissi et al., 2011).

In spite of its significance, bank efficiency has not received much attention in TEs. The relatively new empirical literature on bank efficiency in TEs is either focused on individual countries or a limited number of TEs. The studies that investigate the determinants of bank efficiency, or control for environment, concentrate on the possible impact of foreign ownership. This is because during the transition process the change in ownership, with the increasing presence of foreign investors, has been one of the main structural changes that took place in nearly all TEs. Other determinants of bank efficiency in TEs identified in the literature include competition, institutional reform, privatization, bank age, size and accession to the EU. A brief overview of the studies focusing on individual countries and their key findings is presented in Table 3.1.

Table 3.1 Empirical investigation of bank efficiency in individual TEs

Author (year)	Country	Period	Method.	Type of efficiency	Findings
Hasan & Marton (2003)	Hungary	1993-1998	SFA	cost & profit efficiency	A higher degree of foreign ownership is associated with lower inefficiency; increased entry of foreign banks is associated with greater cost efficiency in all banks, not just those with majority foreign ownership.
Nikiel & Opiela (2002)	Poland	1997-2000	DFA	cost & profit efficiency	Foreign banks are more cost efficient but less profit efficient than other banks.
Kraft et al. (2002)	Croatia	1994-2000	SFA	cost efficiency	New and privatized banks are less cost efficient; privatization does not seem to have an immediate effect on efficiency; foreign banks are more efficient than all categories.
Weill (2003)	Czech Republic & Poland	1994-1997	SFA	cost efficiency	Foreign owned banks are more efficient than domestic owned banks.
Matousek & Taci (2002)	Czech Republic	1993-1998	DFA	cost efficiency	No evidence of greater efficiency in foreign-owned banks; the impact of foreign ownership is robust to the size and structure of activities as well as risk preferences.
Jemric & Vujcic (2002)	Croatia	1995-2000	DEA	technical efficiency	Foreign banks are more efficient than state and private owned banks; new banks perform better than old banks.
Kasman (2005)	Poland & Czech Republic	1995-2003	SFA	cost efficiency & scale economies	Foreign banks have significantly higher efficiency levels than domestic banks.
Tochkov & Neovksy (2011)	Bulgaria	1999-2007	DEA-two step	technical efficiency	Foreign banks are more efficient than domestic private banks; privatization resulted in efficiency gains; capitalization, liquidity, and enterprise restructuring enhanced bank efficiency, whereas banking reforms had an adverse effect;. the Treaty of Accession and EU membership were associated with significant efficiency improvements.

These individual country studies cover the period from early 1990s up to 2003, with the exception of Tochkov and Neovsky (2011) whose sample period extends to 2007. They explore predominantly the relationship between bank ownership and bank efficiency. Most of them investigate cost efficiency only or both cost and profit efficiency. The ones employing SFA control for the exogenous factors directly whereas the other studies usually use two step approaches discussed earlier.

Regarding foreign ownership most of the studies conclude that foreign ownership enhances efficiency and that foreign owned banks are more efficient than domestic banks (Hasan and Marton, 2003; Nikiel and Opiela, 2002; Kraft et al., 2002; Jemric and Vujcic, 2002; Weill, 2003; Kasman, 2005; Tochkov and Neovksy, 2011). Furthermore, Hasan and Marton (2003) observe that increased entry of foreign banks is associated with greater cost efficiency in all banks, not just those with majority foreign ownership. Nikiel and Opiela (2002) find a positive relationship between foreign ownership and cost efficiency but a negative one between foreign ownership and profit efficiency. However, the study by Matousek and Taci (2002) finds no evidence of a positive impact of foreign ownership on cost efficiency even after controlling for size, structure of activities and risk preferences. It is worth noting that the two latter studies employ different methods for obtaining efficiency estimates.

The findings regarding the impact of privatization are conflicting. On the one hand, Kraft et al. (2002) find privatized banks less efficient and concludes that privatization does not have an immediate positive effect on bank efficiency in Croatia. On the other hand, Tochkov and Neovsky (2011) find that privatization resulted in efficiency gains in Bulgaria. Besides the fact that these studies focus on different countries and cover different time periods, the differences in results might also be due to different methods employed. The findings are also conflicting regarding the new banks as well, although the two studies that investigate this relationship focus on Croatia and cover the same time period. Whilst, Kraft et al. (2002) find that new banks are less cost efficient. Jemric and Vujcic (2002) conclude that new banks are more efficient. The study by Tochkov and Neovsky (2011), given its later time period of investigation, is the only one that controls for the impact of accession to EU and finds a positive effect on bank efficiency.

The investigation of bank efficiency based on individual countries, thus, do not provide unambiguous evidence on the positive impact of foreign ownership, privatization, or new the entry of new banks which were the key policies adopted by TEs during the first decade of the transition process. These countries handled the transition process very differently, followed different policies, and had different environments in which banks operated over time and across countries. Therefore, accounting for the environment is essential in bank efficiency studies in TEs.

Consequently, although the above review of the empirical literature on bank efficiency focused on individual countries and given the context of the thesis, the main emphasis should be on the second category of studies, those consisting of cross-country investigations on TEs. Moreover, given that the focus of the thesis is on the environment rather than efficiency levels, more weight is given to studies that explore the impact of the environment. The brief summary of the studies of focusing on several countries and their key findings is presented in Table 3.2.

Table 3.2 Cross-country empirical investigations of bank efficiency in TEs

Author (year)	Countries	Period	Method	Type of efficiency	Findings
Bonin et al. (2005)	11 countries	1996-2000	SFA	cost & profit efficiency	Foreign ownership leads to higher cost efficiency.
Fries & Taci (2005)	15 countries	1994-2001	SFA	cost efficiency	Foreign ownership leads to lower costs and thus higher cost efficiency.
Grigorian & Manole (2006)	17 countries	1995-1998	DEA	cost efficiency	Foreign ownership with controlling power enhances cost efficiency.
Staikouras et al. (2008)	6 countries	1998-2003	SFA	cost efficiency	Foreign ownership is associated with lower inefficiency; there is a negative correlation between cost inefficiency and bank capitalization.
Mamatzakis et al. (2008)	10 countries	1998-2003	SFA	cost & profit efficiency	Foreign banks outperform both state owned and private domestic banks.
Yildirim & Philippatos (2007)	12 countries	1993-2000	SFA & DEA	cost & profit efficiency	Profit efficiency is lower than cost efficiency; profit efficiency is lower for foreign banks compared to domestic and state owned banks; the degree of competition has a positive influence on cost efficiency and a negative one on profit efficiency, whilst market concentration is negatively linked to efficiency.
Koutsomanoli-Filipaki et al. (2009)	10 countries	1998-2003	SFA	bank efficiency	Find strong links between competition and concentration, and bank efficiency.
Poghosyan & Borovicka (2007)	19 countries	1995-2004	SFA	cost efficiency	Positive effect of foreign ownership on cost efficiency may be biased due to the cream-skimming effect (selection bias).
Kasman & Yildirim (2006)	8 countries	1995-2002	SFA	cost & profit efficiency	Foreign banks perform better that domestic banks in terms of profit efficiency; no clear relationship between size and two efficiency measures.

Poghosyan & Poghosyan (2009)	11 countries	1992-2006	SFA	cost efficiency	Greenfield banks are characterized by a higher degree of cost efficiency relative to the domestic banks and foreign banks that entered through cross-border acquisitions; the entry of foreign bank has a positive impact on competition; the results remain unchanged when riskiness of bank portfolio, income from non-interest banking activities and developments in the macroeconomic environment are taken into account.
Fang et al., (2011)	6 countries	1998-2008	SFA	cost & profit efficiency	Foreign banks are associated with higher profit efficiency but moderately lower cost efficiency; government banks are associated with lower profit efficiency; the degree of individual bank's competitiveness has a positive association with both cost and profit efficiency; institutional development has a positive impact on bank efficiency.

The time period and the number of countries covered in these studies vary. The highest cross-sectional coverage is in the study by Pohgosyan and Borovicka (2007), whereas the lowest is in the studies of Staikouras et al. (2008) and Fang et al. (2011). In terms of time period, most of the studies cover a relatively short time span, in the period since early/mid 1990s up to mid-2000s. The study of Fang et al. (2011) covers the longest time span of nine years, with the data extending up to year 2008. Given their longer span, they also apply a time variant specification. However, none of the studies employs more recent data that cover the period of the global financial crisis (GFC). In terms of cross-sectional coverage most of these studies are focused on the banking sectors in CEE countries, less attention has so far been given to SEE countries. Similar to individual country studies these studies investigate predominantly cost efficiency only, or both cost and profit efficiency. Most of them employ SFA with the exception of few that employ DEA or both SFA and DEA.

In terms of the environment, the existing cross-country studies also mainly focus on the impact of ownership. Most of the studies find a positive relationship between bank efficiency, particularly cost efficiency, and foreign ownership (Bonin et al., 2005; Fries and Taci, 2005; Grigorian and Manole, 2006; Staikouras et al., 2008; Mamatzakis et al., 2008; Poghosyan and Poghosyan, 2009). In terms of profit efficiency, Kasman and Yildirim (2006) and Fang et al. (2011) find a positive relationship with foreign ownership. However, a negative impact of foreign ownership on cost efficiency is

documented by Fang et al. (2011) and on profit efficiency by Yildirim and Philippatos (2007). A possible reason behind a negative impact foreign ownership on bank efficiency, particularly on cost efficiency, is that most of the foreign banks started operating in TEs by acquiring domestic banks which had substantial problems particularly with portfolio quality (see section 1.4). Dealing with these issues would have required additional costs, which would outweigh any positive impact of the foreign investor. Poghosyan and Poghosyan (2009) investigate this issue by controlling for whether the foreign bank is a greenfield investment, i.e. was established in the country, or an acquisition. They find that greenfield banks are more cost efficient relative to the domestic banks and foreign banks that entered through cross-border acquisitions.

As previously discussed, the bank efficiency literature in TEs besides completely ignoring the impact of euroization, it largely does not take into account the risk-return aspect associated with banks' operations. Nevertheless, the impact of risk-return aspect on bank efficiency estimates has been demonstrated in a limited number studies that are diverse in terms of cross-sectional coverage (most of these studies are focused on US or European countries, with a very small number of studies focused on TEs). However, most of these studies cover a relatively short time span, the period from early 1990s up to mid-2000s, with the most recent study extending the sample up to 2008, thus none of them cover the period of the global financial crisis (GFC). They mainly use financial capital as a control for risk preferences. In addition, they explore the effect of non-performing loans or loan loss provisions which can be considered as controls for credit risk. In addition to risk preferences and credit risk, most of the existing studies neglect other kinds of risks associated with bank efficiency. Important studies that explicitly account for the impact of risk on bank efficiency are summarized in Table 3.3.

Table 3.3 Empirical investigations of bank efficiency accounting for risk-return aspect

Author (year)	Sample	Period	Method./ Effic.	Risk control	Findings
Mester (1996)	US	1991-1992	SFA/ cost effic.	Risk preferences (financial capital)	Not controlling for quality and risk might be miscalculating banks' level of inefficiency.
Berger & DeYoung (1997)	US	1985-1994	SFA- 2 stage; Granger C./ cost effic.	Risk preference (financial capital); Credit risk (non-performing loans)	Problem loans precede reduction in measured cost efficiency; high measured cost efficiency precedes reduction in problem loans and reductions in capital precede increases in problem loans.
Eisenbeis et al. (1999)	US	1986-1991	SFA & DEA/ cost effic.	Credit risk (loan charge-offs to outstanding loans)	Higher loan losses are correlated with lower efficiency; the SFA scores are more closely related to risk taking behaviour, than those of DEA.
Hughes & Mester (1998)	US	1989-1990	SFA/ cost effic.	Risk signal and cushion (financial capital)	Financial capital serves as a cushion against insolvency and as a signal of bank risk.
Pastor (2002)	Spain, Italy, France, Germany	1988-1999	DEA- 3 stage/ technical effic.	Credit risk (loan loss provisions)	Efficiency estimates not accounting for risk differ significantly from those that account for it.
Williams (2004)	European banks	1990-1998	Granger C./cost effic.	Credit risk (problem loans); Risk preferences (financial capital)	Find a positive relationship between risk taking and efficiency.
Fries & Taci (2005)	15 European countries	1994-2001	SFA/ cost effic.	Risk preferences (capital to total assets); Credit risk (loan losses)	Banking systems with higher ratios of capital to total asset and banks with lower loan losses also tend to have lower costs.
Havrylchyk (2006)	Poland	1997-2001	DEA/ bank effic.	Risk management (ROA volatility)	Find riskier banks more cost and profit efficient.
Yildirim & Philippatos (2007)	12 CEE countries	1993-2000	SFA & DFA/ cost & profit effic.	Risk preferences (capitalization); Credit risk (loan losses)	Higher efficiency levels are associated with large and well capitalized banks and higher level of problem loans is associated with lower efficiency levels.
Altunbas et al. (2007)	European banks	1992-2000	SUR /cost effic.	Risk preference (capital), Credit risk (loan loss provisions)	Find a negative relationship between cost efficiency and bank risk taking.
Chiu and Chen (2009)	Taiwan	2002-2004	SFA & DEA/ cost & technical effic.	Market risk (vector of interest rate changes and exchange rate changes variables)	Risk measures represent significant effects on bank efficiency.
Tochkov & Nenovski (2011)	Bulgaria	1999-2007	DEA- 2 step/ technical effic.	Credit risk(LLP/ loans); Liquidity risk (liqu. level); risk pref.(capital.)	Higher liquidity and capitalization have a positive impact on efficiency.

Fiordelissi et al. (2011)	European countries	1995-2007	Granger-causality/ cost effic.	Risk preferences (financial capital)	Increases in bank capital precede cost efficiency improvements.
Sun & Chang (2011)	8 emerging Asian countries	1998-2008	SFA/ cost effic.	Credit risk (loan loss reserves/gross loans); Market risk (exchange rate volatility, interest rate volatility)	Risk measures represent significant effects on both the level and variability of bank efficiency; these effects vary across countries and over time.

The limited empirical bank efficiency literature that explicitly account for the risk aspect start with the contribution of Mester (1996), Berger and DeYoung (1997), Hughes and Mester (1998) and Eisenbeis et al. (1999), who were the first to explicitly control for risk in bank efficiency studies in the US. Mester argued that studies not controlling for quality and risk might be miscalculating banks' level of inefficiency, and suggested employing the level of financial capital as a control for banks' risk preferences. Berger and DeYoung analysed the relationship between efficiency and risk which they controlled for with non-performing loans. However, they do not control for risk directly in the SFA, but employ the Granger-causality technique to analyse the relationship of efficiency estimates with non-performing loans, and find that higher non-performing loans tend to be followed by lower measured cost efficiency. Eisenbeis et al. also investigated the relationship between efficiency and risk through two stage approaches. They obtain efficiency estimates using SFA and DEA and using Spearman rank correlations find a negative relationship between risk and efficiency. In addition, they find stochastic frontier scores more closely related than linear programing ones to risk taking behaviour. Hughes and Mester investigate the relationship between bank efficiency and risk preferences through the inclusion of financial capital directly in the cost function and find a negative impact of higher financial capital on cost efficiency. Thus, they conclude that financial capital serves as a cushion against insolvency and as a signal of bank risk.

Later, the effect of risk on banking efficiency in European countries started attracting the attention of researchers (Pastor, 2002; Williams, 2004; Altunbas et al., 2007; Fiordelissi et al., 2011). Pastor (2002) investigates this relationship through non-performing loans, which she decomposes into two components: those due to bad management and those due to economic environment. She finds that efficiency estimates not accounting for risk differ significantly from those that account for it. Altunbas et al. (2007) account for differences in banks' risk preferences through the

level of equity capital and find that capital has a negative influence on cost efficiency. Fiordelissi et al. (2011) try to capture the risk on both cost and revenue efficiency through the 5-year ahead cumulative Expected Default Frequency (EDF) for each bank calculated by Moody's KMV and the traditional non-performing loans to total loans ratio. Using the Granger-causality methodology in a panel data framework, they find that increases in bank capital precede cost efficiency improvements.

The literature focused on TEs is limited in comparison to the above (Fries and Taci, 2005; Yildirim and Philippatos, 2007; Tochkov and Nenovski, 2011). Fries and Taci (2005) control for risk through the ratio of non-performing loans to total loans and the capital to asset ratio. They find that banking systems with higher ratios of capital to total asset and banks with lower loan losses also tend to have lower costs. Yildirim and Philippatos (2007) regress the efficiency estimates against capitalization, loan loss reserves and find that higher efficiency levels are associated with large and well-capitalized banks and a higher level of problem loans is associated with lower efficiency levels. Tochkov and Nenovski (2011) regress the efficiency estimates against capitalization, loan loss provisions and liquidity. They find that higher liquidity and capitalization have a positive impact on efficiency. This is the only study that controls for the level of liquidity, which is considered an indicator of liquidity risk.

As explained, most of these studies are limited in controlling for risk preferences and credit risk measures. Most of them investigate the impact of risk-return aspect using two-step approaches, which as explained in section 3.4.3 is problematic. In addition they focus only on credit risk, in this context, the only exceptions are two studies Chiu and Chen (2009) and Sun and Chang (2011), which besides credit risk, control for market risk. Chiu and Chen control for market risk through a vector of variables on the interest rate and exchange rate (changes and levels) and find that risk measures have significant effects on bank efficiency. Sun and Chang (2011) who control for market risk through volatilities of the interest rate and exchange rate, find that they affect both the level and variability of bank efficiency, and that these effects vary across countries and over time. However, both studies focus on Asian emerging markets.

In conclusion, the bank efficiency literature is limited in exploring the impact of the risk-return aspect on bank efficiency. This is a significant gap in literature given the increasing importance of the risk dimension in banking sector and the already documented impact on banking efficiency. Thus, exploration of the risk dimension in TEs is a natural extension of the bank efficiency literature. The thesis intents to fill this gap in the literature through inclusion of various risk measures directly in bank efficiency estimation through SFA.

3.6 Conclusion

This chapter provides the foundation for the analyses in the next chapter as that it identifies the gaps in the bank efficiency literature through a critical review. The chapter began with the main definitions and concepts of efficiency that are considered of interest in this thesis. Given the context of the research it was concluded that cost efficiency will be investigated for a number of TEs. Subsequently, the main methods of estimation and their respective best representatives were discussed in detail. Given its advantages in controlling for the environment, especially bank risk, and its superiority in small and noisy samples, it was decided that SFA will be used in estimating bank efficiency in Chapter 4. The chapter then considered the definitions of the inputs and outputs. Given the advantages over the production approach in terms of risk dimension and following most of the studies in the field, the inputs and outputs will be defined in accordance with the intermediary approach. The discussion then continued with the control variables employed in the literature.

The empirical review showed that the existing literature on bank efficiency has ignored the potential impact of euroization as a key characteristic common to banking sectors and individual bank's balance sheet in TEs. This is a possibly important gap in the bank efficiency literature given the already documented impact of euroization on other banking sector performance indicators. The thesis intends to fill this gap by being the first to provide an investigation of the relationship between bank efficiency and the degree of euroization in TEs. The estimation of this relationship will be done through SFA, whilst controlling directly for degree of euroization in the cost function.

In addition, the review showed that the bank efficiency literature in TEs has been limited in its exploration of the risk-return aspect associated with banks' operations, although, in spite of its increasing importance in the banking industry. There are a handful of studies that explore the risk-return aspect; however, they explore risk through a two-step approach which is criticized for biasness. Furthermore, most of these studies focus only on credit risk and ignore other types of risk. This is another possibly important gap in literature that the thesis intends to fill through inclusion of various risk measures directly in bank efficiency estimation through SFA.

Finally, as the review showed, the existing literature is also limited in terms of the time span covered. Most of the studies include a relatively short time span, in the period since early/mid 1990s up to mid-2000s; the longest time span covered is nine years with the latest year being 2008. Thus, none of the studies employs recent data that cover the period of the global financial crisis (GFC). In terms of cross-sectional coverage most of these studies are focused on the banking sectors in CEE countries, less attention has so far been given to SEE countries. This is an additional gap that the thesis intents to fill by investigating the cost efficiency of banks in a larger number of 20 TEs including SEE countries and covering a longer time span, to be able to estimate the effect of the Global Financial Crisis on cost efficiency of the banks operating in these countries.

Chapter 4

Estimation of bank efficiency through SFA

4.1 Introduction

Chapter 3 provided a critical review of the main literature on bank efficiency and showed that the current literature has ignored the potential impact of euroization, as a key characteristic of banking sectors and individual banks' balance sheets in TEs, on bank efficiency. Furthermore, it showed that, in spite of its increasing importance, the literature on TEs has been limited in its exploration of the risk-return aspect. The main objective of this chapter is to investigate empirically the cost efficiency of banks in TEs, using a stochastic frontier approach (SFA) and explicitly incorporating financial euroization and risk factors in the model. By covering an extended period from 2000 to 2013 (14 years), this study covers a longer period and more data than has previously been available, and broadens the literature by investigating possible links between financial euroization and bank efficiency.

The rest of the chapter is structured as follows. Section 4.2 discusses the SFA efficiency estimation technique. The discussion is structured around the decisions with regard to the distribution of the composed error term, functional form of the frontier, heterogeneity and specific stochastic frontier models. Following the literature review on bank efficiency, provided in Chapter 3, the input, output and control variables are defined in section 4.3. The data used, its sources and the descriptive statistics are elaborated in Section 4.4. The model estimation is discussed in section 4.5 and the estimation results for efficiency estimation are then provided in section 4.6. Section 4.7 discusses the empirical results of the estimation and their implications. The final section concludes the chapter.

4.2 The stochastic frontier analysis (SFA)

As explained in section 3.2, for the purpose of this thesis the focus of the empirical investigation will be on banks' economic efficiency, specifically cost efficiency, which refers to the ability of banks to produce outputs with minimum costs, given the prices of inputs and production technology. The cost efficiency will be estimated through SFA (for an extended discussion of the choice of this technique, see section 3.3). In Chapter 3, the SFA technique has been analysed mainly in terms of its advantages and disadvantages in relation to the DEA technique, whilst in this section it is explored in more depth.

As a parametric approach, the SFA specifies a functional form for the bank efficiency frontier and assumes a compound error term. The best-practice frontier does not necessarily represent the best possible frontier, but merely the best practice frontier observed among banks in the sample (Berger and Mester, 1997). Whilst the frontier is estimated, the stochastic term of the regression model is decomposed into an inefficiency component and a random error component (Bonin, 2004). Banks operating on the isoquant of the best practice frontier are considered cost efficient and those above it inefficient (Kumbhakar and Lovell, 2003). Thus, the deviation of each bank from the best practice frontier represents the bank's inefficiency. As previously mentioned, the key advantages of the SFA technique is that it allows for noise in the measurement of efficiency and for the effects of random exogenous shocks that are beyond the control of the bank (Murillo-Zamorano, 2004), and thus can lead to more accurate estimation of efficiency scores (Greene, 2005). This is particularly important in the context of the thesis given that the focus is on the impact of environmental factors such as financial euroization on bank efficiency rather than on the efficiency estimates.

The stochastic cost frontier has as its arguments the level of outputs and input prices, and has the following general form:

$$\boldsymbol{lnTC_{it}} = \int(\boldsymbol{Y_{it}}, \boldsymbol{W_{it}}, \boldsymbol{Z_{it}}) + \boldsymbol{e_{it}} \qquad \textbf{(4.1)}$$

$$\boldsymbol{e_{it}} = \boldsymbol{u_{it}} + \boldsymbol{v_{it}}$$

Where the left hand side represents the natural log of total cost $\boldsymbol{lnTC_{it}}$ observed for bank $\boldsymbol{i}$ at time $\boldsymbol{t}$ and on the right side: $\boldsymbol{Y_{it}}$ is a vector of output levels, $\boldsymbol{W_{it}}$ is vector of input prices and $\boldsymbol{Z_{it}}$ stands for a set of control variables. Finally, $\boldsymbol{e_{it}}$represents the compounded error term, which consists of the inefficiency component $\boldsymbol{u_{it}}$ and the random error component $\boldsymbol{v_{it}}$.

With SFA, there are several decisions that need to be made with regard to the compound error term, the functional form of the frontier and the specific stochastic frontier model, which are discussed in detail below. The specification of the functional form for the efficiency frontier can be considered a limitation of this

approach, given that the specified form may not necessarily fit the data (Bauer et al., 1998).

4.2.1 The compound error term

Within the compound error term, the $\boldsymbol{v_{it}}$ component corresponds to random fluctuations, and follows a symmetric normal distribution around the frontier$\left(\boldsymbol{v_i \sim N(0, \delta^2)}\right)$**.** The other component $\boldsymbol{u_{it}}$ is the inefficiency component of the error term and is assumed to have an asymmetric distribution. The rationale for different distributions is that "inefficiency cannot diminish costs and thus must have an asymmetric distribution, whereas random error can add to or subtract from costs and therefore has a symmetric distribution" (Weill, 2003, p. 579). The $\boldsymbol{u_{it}}$ component is assumed to follow either an exponential, half normal/truncated normal, or gamma distribution. As suggested by Forsund et al. (1980, p.11) "there do not appear to be good a priori arguments for any particular distribution." Many distribution models have found application in the literature: Berger and De Young (1997) use the truncated normal model; Mester (1993) uses the half-normal distribution; Greene (1990) uses the normal-gamma model. According to Altunbas and Molyneux (1994) all distribution models yield similar results and efficiency estimates are relatively insensitive to different distributional assumptions. However, the half-normal and the truncated normal are the most frequently used models. Whilst the gamma distribution can potentially increase the flexibility of the model, in practice the problems of identification seem to outweigh the potential gains of this distribution (Greene, 1997, p.103). Kumbhakar and Lovell (2003) argue for the use of a relatively simple distribution such as half-normal or exponential. However, according to Van den Broeck et al. (1994), the truncated normal distribution function better distinguishes between statistical noise and inefficiency terms. For the purpose of this research the truncated normal distribution will be used as this is one of the most frequently used models in the literature. The choice of the distribution can also depend on the details of the particular stochastic frontier model (SFM) used (see for instance section 4.2.3).

4.2.2 Functional form of the frontier

There are several different functional forms used in the literature with regard to the shape of the frontier. The choice between them is not straightforward, given that the true shape of the frontier is unknown. According to Greene, (2005, p.98), the choice of the functional is generally "tangential to the analysis". However, empirically the choice matters because different assumption may lead to different results, even though the authors usually do not explain the rationale behind their choice. Coelli et al. (1998) and Kumbhakar and Lovell (2003) discuss this issue at some length. The Cobb-Douglas model, the translog model and the Fourier flexible functional form are the most common models that have found application in the literature.

The Cobb-Douglas model, introduced by Cobb and Douglas in 1928, is considered the conventional functional form. It has been one of the most popular functional forms because of its simplicity in estimation and interpretation. However, according to Greene (2007) due to its simplicity the model may produce biased efficiency estimates because the un-modelled complexities go into error term. In addition, the simple structure does not allow the accommodation of a multiple outputs production technology. It also assumes a constant technological change effect and constant elasticities making it inadequate in cases when elasticities may vary across banks (Coelli et al., 1999). Nevertheless, it is preferred when dealing with small number of observations (Fitzpatrick and McQuinn, 2005).

The translog model, introduced by Christensen et al. (1973), is a more flexible form than the Cobb-Douglas. It allows for the technological change effect to vary with the level of output. It can accommodate multiple outputs without necessarily violating the curvature conditions. The translog model is applicable in banking studies because, as Murray and White (1983) suggest, it captures the heterogeneous nature of a bank's intermediation activity. It is also considered appropriate when a large sample is available because it requires the estimation of a large number of parameters (in comparison with the Cobb-Douglas form) so that to maintain the same degree of freedoms it needs more observations. Due to the high number of parameters estimated, the translog model may suffer from multicollinearity which can lead to high standard errors of the regression coefficients (Cohen and Gujarati, 1970), particularly if the sample size is small. However, these limitations can be eliminated when the model is estimated through a system of equations or with panel

data given that this increases the number of observations (Kumbhakar and Lovell, 2000). Finally, both Cobb-Douglas and translog models are problematic when the data contain zeros because this makes it impossible to construct the logarithms of the variables (Coelli et al., 1998).

The Fourier flexible functional form, introduced by Gallant (1982), is more flexible than the translog form and provides a universal approximation to any cost or profit frontier function. It has been frequently used in the bank efficiency studies (DeYoung and Hasan, 1998; Berger and Mester, 1997; Altunbas et al., 2001; Girardone et al., 2004; Weill, 2004). The Fourier model consists of two parts: the usual translog function and the non-parametric Fourier expansion (Koenzler, 2005). Therefore, it may suffer from the same disadvantages as the translog form (Coelli et al., 1998), only more so. The number of parameters to be estimated in the Fourier form is always greater than the translog form, thus a potentially better fit of the Fourier form comes at a price of the loss of degrees of freedom and consequently, inferior statistical accuracy (Koenzler, 2005).

The choice of the functional form is not an issue that has received much attention in the stochastic frontier applications. Studies usually do not elaborate on the rationale behind their choice. In general, the Cobb-Douglas and translog models dominate the literature on SFA inefficiency estimation (Greene, 2005). The initial studies used the Cobb-Douglas function models, whereas the translog models dominate the literature from the mid-1980s onwards (Amsler et al., 2009). The strong underlying assumptions of the Cobb-Douglas functional form are considered a high price to pay for its simplicity as an advantage. Cobb-Douglas is usually preferred when dealing with a small sample size, given the trade-off between flexibility and the degrees of freedom. This is not the case with relatively large samples such as the one employed in this thesis, enabling the use of a flexible form. Fourier form is the most flexible form but its construction is quite complex, which restricts it use. The translog form is arguably flexible enough and it is fairly easy to estimate and interpret. Consequently, for the purpose of this research the translog form is preferred.

4.2.3 Heterogeneity and efficiency estimates

Greene (2005a) highlights the issue of heterogeneity in SFA which was not completely missing from the earlier literature; however, he develops it in much more depth. He argues that it is very important to incorporate heterogeneity in SFA models because if it is not accounted for, it is most likely that it will be treated as inefficiency. Heterogeneity can be observable and unobservable. Observable heterogeneity is captured by measured variables that can be explicitly employed in the regression functions and shift the cost function or the inefficiency distribution. The variables can also be scaled in a way "that enter in the form of heteroskedasticity" (Greene, 2007, p.70). Unobserved heterogeneity is captured in the model as an effect or a characteristic which can reflect missing variables. Greene argues that that efficiency studies must differentiate one type of heterogeneity from the other. In addition, they must also make a distinction between heterogeneity in the cost function from the inefficiency part, given that they have different implications for modelling and estimation (Greene, 2007).

For a long time, following Pitt and Lee (1981), efficiency studies have accounted for observed heterogeneity through a two-step approach. Initially they estimated efficiency disregarding any observed heterogeneity or exogenous variables. Then they regressed, or in some cases correlated, the obtained efficiency estimates with the identified exogenous variables. Later this approach has been heavily criticized for persistent bias (Wang and Schmidt, 2002). Disregarding the heterogeneity at the first step leads to bias estimates that are then carried forward into the second step. The problem is comparable to that with omitted variables. Consequently, any observed heterogeneity should be explicitly incorporated in the model at the first step (Kumbhakar et al., 1991; Caudill and Ford, 1993; Battese and Coelli 1992; 1995; Caudill et al., 1995; Wang and Schmidt, 2002; Kotzian, 2005; Greene, 2007). To avoid these problems, observed heterogeneity should be controlled for directly in a one-stage regression. It can be explicitly introduced into the models through a vector of environmental characteristics to model the differences in either the shape of the frontier or the mean or/and the variance of the inefficiency component. If the environmental characteristics are assumed that influence the shape of the frontier they ought to be included directly into the frontier function as regressors. However, if they are assumed to influence the degree of efficiency and not the shape of the

frontier they ought to be modelled into the inefficiency component. Whilst the first approach produces efficiency scores independent of environmental influences, the second approach produces efficiency scores which incorporate the above mentioned characteristics (Kumbhakar and Lovell, 2003; Koenzler, 2005; Greene, 2005a).

4.2.4 Stochastic frontier model

Applications of frontier models have involved the use of both cross-section and panel data models. Stochastic frontier models employing cross sectional data disregard possible time effects and can only estimate the efficiency of each bank in a specific period. They are generally estimated by Maximum Likelihood Estimation (MLE). In their efficiency estimates, they cannot separate bank specific effects that are unrelated to efficiency (Battese and Coelli, 1995). In addition, they assume that errors are independent of regressors. This may be an incorrect assumption, because, as argued by Schmidt and Sickles (1984), a bank's awareness of its inefficiency level should affect its input choices.

Some of the above-mentioned assumptions can be relaxed and limitations overcome when panel data is employed. Panel data contains more information than a single cross section and increases the sample size, which can increase the precision of estimators (Kumbhakar and Lovell, 2003). Panel allows for the separation of bank specific and time specific effects from efficiency estimates data (Mastromarco, 2008). It also allows for the investigation of dynamic changes over time, thus enabling the estimation of the time pattern of efficiency for each bank. In addition, with a panel the problem of the independence of regressors assumption is solved because banks are observed at several points in time, which can serve as a substitute for the independence assumption *(*Kumbhakar and Lovell, 2003).

Stochastic frontier models employing panel data methods, in general, have significant advantages over cross section methods. The advantages and limitations are extensively summarized in Sena (2003) and Kumbhakar and Lovell (2003). Depending on their underlying assumption regarding efficiency, stochastic frontier panel models fall into two main categories: time variant and time invariant. Each category can then, be further divided into subcategories.

Time invariant models

The time invariant models assume that efficiency varies across banks, but it remains constant over time and, following Kumbhakar and Lovell (2003), are sub-categorized into Fixed Effects (FEs), Random Effects (REs) and Maximum Likelihood (ML) models.

The fixed effect model has been employed in efficiency estimation, initially by Schmidt and Sickles (1984), to overcome problems with the pooled data model. The frontier is shaped by one bank which is regarded as the most efficient. The inefficiencies of other banks are measured relative to this bank. FE does not make any assumption regarding the distribution of the random noise, but it does assume that it is uncorrelated with the regressors. The inefficiencies are treated as fixed effects or bank specific constants and are allowed to be correlated with the regressors or the random noise. FE is simple; it has good consistency properties and can be estimated through Ordinary Least Squares (OLS). However, the fixed effects model instead of capturing variations in efficiency across banks, picks up the effect of all of a bank's sources of heterogeneity, including those not related to inefficiency. In addition, it does not allow time invariant variables to be included among regressors.

The random effects model does not assume a specific distributional assumption about inefficiencies but assumes they are uncorrelated with the regressors and the random noise. It allows the presence of time invariant regressors. REs can be estimated through standard two-step generalized least squares (GLS). Its main advantage is that it allows time invariant variables among regressors, whereas its main shortcoming is that it requires the random effects to be uncorrelated with regressors which removes the advantage of using panel data in first place.

The Maximum Likelihood models, initially used by Pitt and Lee (1981), are in essence cross sectional models extended to panel data and estimated through Maximum Likelihood Estimators (ML). According to Kumbhakar and Lovell (2003), ML models with time invariant efficiency are very similar to the cross section models in the sense that the strong distributional assumptions remain. They argue that due to these assumptions, they exploit distributional information that FE and RE do not, thus their efficiency estimators are preferred to those of FE or RE (Kumbhakar and Lovell, 2003, p.106). Hallam and Machado (1996) and Bravo–Ureta and Ahmad (1996) also find that ML provides better measures of the efficiency scores, and enables the modelling

of the impact of external factors on efficiency (Sena, 2003). Consequently, ML models are widely applied in the literature.

The three approaches discussed above impose different requirements on the data and have different properties. Nevertheless, the empirical comparison of the approaches reported in the literature (Bauer et al., 1993; Bauer and Hancock, 1993) find that these three approaches are likely to generate a similar efficiency ranking, particularly at the top and the bottom of the distribution. Their main limitation is that they maintain that the efficiency is time-invariant. They allow efficiency to vary across banks, but assume it remains constant through time for each bank. The assumption of time invariance of technical efficiency is strong and does not hold in the long run (Cornwell et al., 1990; Kumbhakar and Lovell, 2003; Sena, 2003; Greene, 2005). Given the relatively long time series component of our panel, the assumption that efficiency is invariant cannot be justified; thus, we turn to the second main category, the time variant models.

Time variant models

The time variant models allow efficiency to vary across banks and through time. They are either cross-sectional MLE models extended to the panel data context or traditional panel models (FE or RE) extended to account for time variance. Cornwell et al. (1990), Kumbhakar (1990), Battese and Coelli (1992), and Lee and Schmidt (1993) are amongst the first to use a stochastic frontier panel data model with time varying efficiency. Cornwell et al. (1990) allow efficiency to vary through time by including a flexible function of time. In their specification a bank's inefficiency increases or decreases infinitely with time in quadratic form. Kumbhakar (1990) treats efficiency as an exponential function of time. In his model, inefficiency converges to a finite level as T grows, but this also means that inefficiency varies little for large T. Consequently, for both of these approaches their applicability is questioned for investigations covering long panels (Ahn et al., 2000). Kumbhakar (1990) also includes a time indicator among regressors, and separates the effect of technical change from that of efficiency change. His model was the basis of an alternative time varying efficiency model proposed by Battese and Coelli (1992). Their model treats inefficiency as an exponential function of time. They assume that efficiency must either increase at a decreasing rate, decrease at an increasing rate or

remain constant. They also include a time element to control for technical change. The Kumbhakar (1990), and Battese and Coelli (1992) models also imply that the temporal pattern of efficiency is the same for each bank and they do not allow for a change in the rank ordering of the banks over time - a bank remains at the same rank as in the first period. The Lee and Schmidt (1993) model allows efficiency to vary over time through time dummies, thus, whilst the pattern of variation is unrestricted it is common to all individual banks.

The Battese and Coelli (1995) model is another model, extended to panel data, which defines efficiency as a function of bank-specific explanatory variables and time. In this model efficiency follows a truncated-normal distribution that is independently, but not identically, distributed over different banks. This model allows controlling for the impact of bank characteristic variables directly into efficiency and does not restrict the same ordering of banks in terms of efficiency over time as the Battese and Coelli (1992) does. The model permits the investigation of the determinants of efficiency, inefficiency and the technological change over time simultaneously. The Battese and Coelli (1995) model is the most frequently applied model in the literature and continues to be the model of choice in many recent applications (Greene, 2007).

Other models developed later are the True Fixed and Random Effects introduced by Greene (2005b) as a solution to the time invariant efficiency limitation of the standard FE and RE approaches. Standard FEs and REs approaches also do not control separately for possible heterogeneity unrelated to efficiency: this is forced into the inefficiency estimates and, as Greene (2005b) argues, this can lead to distorted efficiency estimates. He addresses these limitations through his models, which enable the separation of time variant efficiency from bank specific time invariant heterogeneity. He integrates the FEs and REs approaches into the original Aigner et al. (1977) model, allowing for time variant efficiency while controlling for bank specific unobserved heterogeneity through fixed or random effects. They can be estimated using MLE given that the inefficiency term follows a distributional form. Whilst the estimation of the true REs model is relatively straightforward, the same cannot be said for the true FEs model. The main difficulty is that the estimation of a true FEs model is numerically cumbersome due to the large number of parameters. The second problem is the incidental parameters problem. With a short panel and a large number of banks, the fixed effects are inconsistently estimated (Neyman and

Scott, 1948; Lancaster, 2002; Greene, 2005b). Belotti and Ilardi (2012), propose the use of Maximum Likelihood Dummy Variables (MLDV) approach as a solution to this problem when the panel is large enough (at least 10 years). To conclude this discussion, the true RE model appears as the most flexible choice among the time variant models although it has been criticized on the basis that a part of the time invariant unobserved heterogeneity does belong to the inefficiency and that these two components should not be separated (Belotti et al., 2012).

Having described the relevant models for the estimation of bank efficiency, and taking into consideration the importance of time variant efficiency due to lengthy panel employed in the investigation and the crucial importance of heterogeneity in the context of this thesis the Battese and Coelli (1995) model and the Greene TRE (2005) model will be both applied in the investigation in this chapter. As explained above the BC 1995 model is the most frequently applied model in the literature and continues to be the model of choice in many recent applications. Whereas Greene TRE 2005 although little used, it has the advantage of allowing for unobserved bank random effects separately from inefficiency. By employing both specifications, we are able to compare and draw on the strengths of both.

4.3 Definition of variables

The identification of inputs and outputs is one of the most debated topics in the studies on banking efficiency -mainly because the results of efficiency estimates are sensitive to the specification of inputs and outputs, whereas their identification is not straightforward given the complex nature of banks (Berger et al., 1993). For the purpose of this study, the intermediary approach to inputs and outputs is followed. The extended discussion on the choice of the approach is eschewed here given that is was provided in section 3.4.

Banks use multiple inputs to produce multiple outputs and are accordingly modelled. For the estimation of the cost efficiency frontier, the total costs, prices of inputs and volumes of outputs are employed. It is assumed that banks are price takers in input markets. Banks are operating either on that frontier, if they are perfectly efficient, or beneath the frontier, if they are not fully efficient. Efficiency improvement can be achieved through technological change or through a more efficient use of the existing

technology (Coelli, 1995). An underlying assumption of efficiency estimations is that the technology is common to all banks. Orea and Kumbhakar (2004) argue that this can be a strong assumption given that not necessarily all banks use the same technology, nevertheless controlling for the technology banks use is virtually impossible. Studies usually attempt to do so by categorizing banks in terms of their specialization (Mester, 1993) or in terms of the region (Mester, 1997). However, with regard to specialization, the differences between categories of banks in TEs are typically small. Most banks are heavily focused in retail even if they are identified as investment banks, mainly due to the underdeveloped financial markets. Whereas, with regard to region controlling for it is not possible when investigating TEs. In addition, when the translog functional form is employed no a priori restrictions on the underlying technology are necessary given that translog is a locally flexible form. Still, following Fries and Taci (2005) by controlling for variables other than inputs and outputs which can have a significant effect on the technology, we recognize that technology can vary systematically across countries.

Following the literature review provided in the third chapter, the following variables are employed in the model of this investigation.

4.3.1 Outputs:

- Loans, measured as total loans less reserve for loan loss provisions (Y1);
- Investment, measured as the sum of total securities, equity investments and other investments (Y2).

Quality differences in outputs provided is an important issue that deserves a careful consideration. Bank efficiency studies have tried to account for variation in the quality of output in a variety of ways. One way of controlling for quality differences measure is incorporating quality differences directly into the output (Battese and Coelli, 2005) which we are doing by subtracting loan loss provisions from total gross loans.

4.3.2 Input prices:

The input prices used to estimate the frontiers are:

- Price of labour, measured by the ratio of personnel expenses to total assets (W1) (in absence of the data for total employment);
- Price of borrowed funds, measured by the ratio of interest expenses to total funding (customer deposits and short term funding plus other funding) (W2);
- Price of physical capital, measured by the ratio of other operating expenses to total fixed assets (W3).

4.3.3 Control variables

In addition to traditional outputs and input prices, a series of control variables are included in the model. This is because ignoring the impact of the environment in studies using common frontier approach makes efficiency estimates persistently biased and unreliable (Greene, 2005). Accounting for the environment is particularly important in TEs given the dynamics of their banking and economic development during the transition process in the last two decades (see section 3.4.3 for a more detailed discussion). The following are the control variables employed in this investigation for this reason. Whilst the rest of the control variables can be categorized into two sets: macroeconomic environment variables and bank-specific variables, we will start with financial euroization, which is the key variable of interest for this study.

Financial euroization

In the investigation presented in this chapter, the key contribution is looking at the impact of financial euroization on the cost efficiency of bank in TEs. As discussed in the literature review presented in Chapters 2 and 3, the existing literature neglects this factor. In order to take this into consideration we control for financial euroization at country and bank levels to better explore the effect of both the general environment and the bank's own choices. In addition, as previously discussed in section 3.4.3, control variables in stochastic frontier analysis can be incorporated in the efficiency frontier if they are expected to shift the entire frontier or in the inefficiency component of the composed error term if they are expected to impact the distance of the individual bank from the efficiency frontier. Financial euroization at

country level, measured as the share of foreign currency loans in the total loans of the banking sector, is incorporated in the efficiency frontier as an individual bank's decisions has little effect on the degree of euroization of the entire banking sector. The financial euroization at bank level, measured as the share of foreign currency loans in the total loans of each bank is incorporated in the inefficiency component. This is because the bank can change the structure of their portfolio and this is expected to influence the distance of individual banks to the frontier i.e. their inefficiency.

Theoretically, the impact of the euroization on bank performance is ambiguous. Banks lend in foreign currency in order to hedge against foreign currency risk, which they are exposed to when some of their liabilities are denominated in foreign currency. However, this hedging strategy is dependent on whether the bank's clients are hedged against foreign currency risk. If not, then by lending in foreign currency, banks merely transform a part of the currency risk they are exposed to into credit risk. Thus, depending on the degree of the risk passed or transformed the expected relationship with performance is ambiguous (an extensive discussion is provided in section 2.4). Although the empirical literature ignores the interaction of euroization and bank efficiency, it has investigated its impact on bank performance measures such as bank stability and crises. However, the existing literature has not reached a consensus on the impact of financial euroization and these measures of bank performance (De Nicolo et al., 2003; Arteta, 2003; Levy Yeyati, 2006; Shinichi, 2007). Most studies find that financial system development is adversely impacted by euroization, but a few studies indicate that euroization is beneficial in terms of asset quality and some others that find no significant relationship (see section 2.5.3 for a detailed discussion). Arguably, either a negative or positive impact of financial euroization on bank efficiency can be expected.

Macroeconomic and banking sector environment

This set of control variables is included to reflect the changing operating conditions in countries in which banks optimize their operations. This allows for the level of efficiency to vary systematically across countries. The first few are incorporated to control for general economic differences that may affect banks' operations and the latter ones are used to control for important characteristics of the banking sector.

- **Economic development**

Macroeconomic variables are included to reflect the changing operating conditions in which banks optimize their operations. This allows for the level of efficiency to vary systematically across countries. They enable control over variation in banking technologies that may be related to macroeconomic conditions and to institutional features of a country (Fries and Taci, 2005). This approach is preferred to using country dummy variables, given that these can only establish cross-country differences but cannot explain the sources of differences. Following the findings of the literature review provided in Chapter 3, GDP per capita, GDP growth and inflation are employed to control for the size of the economy, economic development and macroeconomic stability, respectively. Greater economic development and greater economic stability are expected to be linked positively to bank efficiency (Grigorian and Manole, 2002; Fries and Taci, 2005; Yildirim and Philipatos, 2007).

- **Quality of institutions**

The recent global financial crisis has been a reminder of the impact of institutional and regulatory environment on banks' risk taking and performance (Houston et al., 2010). The banking sector reform index (BSRI) produced by the European Bank for Reconstruction and Development (EBRD), which ranks countries on a scale of 1 to 4+ on the basis of their progress in liberalisation and institutional reform of the banking sector, is included to control for the variation of institutional quality across countries. A score of 1 represents little change from a socialist banking sector apart from the separation of the central bank and commercial banks, while a score of 4+ represents a level of reform that approximates the institutional standards and norms of an industrialised market economy. By accounting for the variation in banking sector quality across countries, this research can provide valuable empirical evidence that complements and extends the existing research related to bank efficiency. Higher quality of institutions is expected to be linked positively to bank efficiency.

- **Market Competition**

The extent of market competition is proxied by the degree of concentration measured by the HH index. The literature is ambiguous on the impact of bank competition on bank efficiency. Higher competition should provide an incentive for banks to operate

closer to the best practice frontier. However, a bank may have become large because it was more efficient in the past. Yildirim and Philipatos (2007) find that competition is positively associated with cost efficiency.

- **Foreign ownership**

The degree of foreign ownership is included to control for possible impact of ownership. The effect of foreign ownership has been widely investigated in bank efficiency studies covering TEs; however, the results are conflicting. Nikile and Opiela (2002); Hasan and Marton (2003); Fries and Taci (2005); Bonin et al. (2005); and Yildirim and Philippatos (2007) argue that foreign banks apply greater competitive pressure in the system in comparison with domestic ones and find that foreign banks are more cost efficient. In the other hand, Fang et al. (2011) find that foreign banks are associated with moderately lower cost efficiency.

- **Time dummies**

To account for changes in technology over time, and following Battese and Coelli (1992, 1995) a time dummy is included in the frontier. Although various studies use a time trend to control for technological progress, the use of a time dummy is preferred given that technological progress is not necessarily constant or uniform. In addition, time dummies pick up other year-specific circumstances, thus reducing the possibility of cross sectional dependence increasing the validity of estimation process (Sarafidis et al., 2009).

Bank characteristics

Besides the macroeconomic variables that establish the environment within which banks operate, bank efficiency may depend on bank-specific characteristics. We are particularly interested in investigating the relationship between the risk aspect and bank efficiency. Traditional bank efficiency models have been criticized on the grounds that they do not take into account the risk-return aspect - "they assume that banks are risk neutral and ignore risk-taking" (Sun and Chang, 2011, p.1728). Hughes and Mester (1993), and Mester (1996) both argue that risk characteristics need to be incorporated in bank efficiency studies since not controlling for risk might lead to biased efficiency estimates. Most of the studies that control for risk when

investigating bank efficiency account only for credit risk through non-performing loans and allowance for loan losses, but other risks are also possibly associated with bank efficiency. Banks are exposed to various types of risk that, since 2001, are categorized by the Basle Committee into three main ones: credit, market, and operating. Therefore, the credit risk indicators are no longer good overall representative indices of bank risks. For an extensive discussion on the relationship between risk and bank efficiency refer to the section 3.5. The following variables are employed to control for risk.

- **Credit risk**

Loan loss provision as a fraction of net loans is employed to control for credit risk. Following the literature a negative relationship is expected with bank efficiency (Hughes and Mester, 1993; Berger and DeYoung, 1997; Esienbeis et al., 1999; Pastor, 2002; Fries and Taci, 2005; Tochkov and Nenovski, 2011; Fiordelissi et al., 2011).

- **Operational risk**

Following Yildirim and Philipatos (2007), the ratio of total loans over total assets is employed to control for operational risk. A negative relationship with bank efficiency is expected.

- **Market risk**

Market risk is modelled by controlling for the Net Interest Margin (Haselman and Wachtel 2007). A negative relationship with bank efficiency is expected.

4.4 Data

Following the vast majority of studies on bank efficiency, this study uses banks' balance sheet and income statement data for banks operating in 26 European Transition Countries obtained from the BankScope database prepared by Bureau van Dijk. The study follows IMF's classification of European Transition Economies namely: **CEE** (Albania, Bulgaria, Croatia, Czech Republic, FYR Macedonia, Hungary, Kosovo, Poland, Romania, Slovak Republic, Slovenia); **Baltics** (Estonia, Latvia, Lithuania) and **CIS** (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyz Republic,

Moldova, Russia, Ukraine, Uzbekistan). The length of the panel is fourteen years, from 2000 to 2013.

BankScope database is widely used in the literature (Girardone et al., 2009; Casu and Molyneux, 2003; Pastor and Serrano, 2006; Lozano-Vivas et al., 2002; Casu and Girardone, 2006; Pastor et al., 1997; Weill, 2004; etc.) given than it provides harmonized financial data using international accounting standards and a convenient statement in a common currency. Thus, it is very attractive for cross country comparative studies. However, despite its broad application its limitations are not widely addressed. Most studies do not even mention these limitations; they eschew their discussion with a few brief statements that the data needed cleaning but do not expand further on the matter. The reality is that data for banks operating in less developed and transition countries require substantial cleaning before a reliable sample can be constructed. Considering that authors do not elaborate on the steps undertaken on dataset preparation we developed our own method for cleaning the BankScope data.

- First, the data needed careful reviewing to avoid double counting of banks and to exclude central banks and other non-bank financial institutions from the sample.
- Second, there were numerous banks that had data only for one year. These were excluded, given that it was decided to include in the sample banks that have a minimum of continuous two years of data. Consequently, Armenia, Azerbaijan, Kazakhstan, Kyrgyz Republic and Uzbekistan were left out of the database because the bank data for these countries were barely covering a year
- Third, a decision on the appropriate accounting standards had to be made for cases when banks reported in both international financial reporting standards (IFRS) and local generally accepted accounting principles (GAAP). IFRS reports were used wherever possible, but we were constrained to also rely on the local ones (GAAP) where this was the only available data.
- Fourth, the database has a considerable amount of missing values which might be considered problematic. However, the database is used by almost every study on bank efficiency, with most of them not even acknowledging the problem of missing values. We are following this literature using the database, assuming that these values are missing completely at random which is a strong assumption. The only possible solution to this would be cross checking with individual annual

reports for each bank, which is a very cumbersome task and was considered a too lengthy a procedure for this thesis- and may also prove to be problematic.

- Finally, a number of dubious observations with negative values for several important variables such as total loans, total cost, total investment and total equity, that could not have been negative, were found. After a careful analysis, it was noted that the negative values were usually four or five observations for the entire variable, thus they were treated as missing observations (See Appendix 4.1 for the detailed description of the cleaning process of the database).

Besides the process of cleaning the BankScope database, obtaining data for the key variable of interest, financial euroization, has been one of the main challenges of this investigation. BankScope does not report foreign currency loans at the individual bank level. This is because this information is considered to be of a sensitive nature and even confidential in some countries. Taking this into consideration the analysis is conducted in two parts. In the first part, using a large database, the relationship between financial euroization and bank efficiency is explored using the degree of euroization at country level. The data on euroization at country level was obtained from the central banks of respective countries. This required considerable effort given that the share of foreign currency loans in total loans of the banking sector is not reported in a straightforward manner. Thus, the variable was calculated by the author using data from monetary surveys of central banks. This part of the research is carried out using an unbalanced panel of 1541 banks operating in 20 TEs. The number of banks in each country is shown in Table 4.1.

Table 4.1 The number of bank across different countries in the large database

Country	Number of banks	Country	Number of banks
Albania	16	Lithuania	10
Belarus	29	Macedonia, FYR	19
Bosnia and Herzegovina	32	Moldova	17
Bulgaria	29	Poland	53
Croatia	43	Romania	30
Czech Republic	32	Serbia	34
Estonia	9	Slovenia	20
Hungary	43	Slovak Republic	20
Kosovo	6	Ukraine	31
Latvia	22	Russian Federation	1062
Total		**1541**	

In the second part, the relationship between financial euroization at bank level and bank efficiency is explored. Obtaining the data on bank level euroization required a huge amount of effort and time. Although the author approached to respective central banks for the bank level data on financial euroization, assuring them of the confidentiality and proper use of the data, they declined to provide this data. Therefore, the author had to refer to individual banks official websites and calculate it using data from annual reports or external auditor's reports published by banks. This was a very cumbersome and lengthy task and only a smaller database could be constructed for banks in SEE countries. This part of the analysis is carried out using an unbalanced panel of 126 banks operating in 7 TEs. The number of banks in each country is shown in Table 4.2.

Table 4.2 The number of bank across different SEE countries in the small database

Country	Number of banks
Albania	16
Bosnia and Herzegovina	22
Bulgaria	27
Croatia	14
Macedonia, FYR	11
Serbia	23
Slovenia	14
Total	**126**

In the two sets of data the time period coverage differs considerably by bank, with a time span varying from two to thirteen years. Given the length of the time series, there is good scope for investigating the evolution of the impact of financial euroization on cost efficiency over time.

Table 4.3 Detailed description of variables

Variable	Symbol	Description	Source
Total Cost	TC	Interest + non-interest expenses	BankScope
Outputs			
Total Loans	Y1	Net loans (Gross loans – reserve for loan loss provisions)	BankScope
Total Investments	Y2	Total securities + equity investment + other investment	BankScope
Inputs prices			
Price of labour	W1	Price of labour=personnel expenses/total assets	BankScope
Price of borrowed funds	W2	Price of borrowed funds = interest expenses/(customers deposits + short term funding + other funding)	BankScope
Price of physical capital	W3	Price of physical capital = other operating expenses/fixed assets	BankScope
Control variables			
Macroeconomic and banking sector environment			
GDP per capita	GDPc	GDP per capita	World Bank
GDP growth	GDPg	Real GDP growth	World Bank
Inflation	I	The percentage change in the CPI	World Bank
Banking Sector Reform Index	BSRI	EBRD index	EBRD
Market competition	HHI	Herfindahl Hirschman Index, calculated by the author	BankScope
Foreign ownership	FO	Banks with assets of foreign ownership > 50%	EBRD
Financial Euroization	FE_sector	Share of FC loans/total loans in the banking sector	Central banks
Bank characteristics			
Financial Euroization	FE_bank	Share of FC loans/total loans of the bank	Individual banks
Credit risk	CR	Loan loss provision/total loans	BankScope
Operational risk	OR	Total loans/total assets	BankScope
Market risk	MR	Net Interest Margin (NIM)	BankScope
Time dummy	T		

The remaining aggregate variables, for the countries of our sample are obtained from various sources such as EBRD, World Bank and respective central banks. The details regarding the variables, in terms of symbols, description and data sources are presented in the previous page in Table 4.3.

Descriptive Statistics

The descriptive statistics for the variables used in the bank efficiency model is presented in Table 4.4. Although natural logarithms of total cost, outputs and input prices are used in estimating the efficiency scores, we present the mean and standard deviations in levels to be more informative. As seen below, there is a considerable variation in most of the variables.

Table 4.4 Descriptive Statistics

Large Database	Obs	Mean	ST Dev	Min	Max
Total cost	12684	131468	705392	16.7	8184727
Total Loans	12628	102991	7313931	1.01	400000000
Investments	10978	327658	1945948	0.3	74000000
Price of labour	12711	0.30	0.025	0.01	.35
Price of borrowed funds	12317	38.20	2053	0.1	219887
Price of physical capital	12677	31.23	274.77	0.1	15224
GDP_c	21175	5557.2	4300.5	354	26989.7
GDP_g	21175	3.23	3.29	-17.95	12.23
Inflation	21047	16.99	24.27	-1.15	168.62
BSRI	21218	2.67	0.734	1	4.33
FO	21218	0.58	0.26	0	0.99
HHI	21218	1279.1	840.37	324	6584
CR	11882	7.93	9.11	1.01	108.87
OR	12679	53.79	19.56	1.03	99.44
MR	12684	6.40	4.01	-28.63	79.1
FE_sector	21161	0.55	0.22	0	0.94
Small Database	**Obs**	**Mean**	**ST Dev**	**Min**	**Max**
Total cost	1337	80413	150902	237.88	1700000
Total loans	1336	791299	1511327	700	15000000
Total investments	1250	180254	329363	2.76	2500000
Price of labour	1339	0.01	0.10	0.01	1
Price of borrowed funds	1327	0.06	0.18	0.01	3.68
Price of physical capital	1339	1.67	3.13	0.1	4482
GDP_c	1698	6507.67	5704.77	809.28	26989.7
GDP_g	1698	3.11	3.28	-7.94	9.3
Inflation	1610	7.19	13.74	-0.74	95.01
BSRI	1698	2.98	0.56	1	4
FO	1698	0.70	0.26	0	0.95
HHI	1698	1484.09	674.37	638	4238
CR	1231	8.25	9.11	0.14	97.95
OR	1337	55.49	15.48	0	90.39
MR	1336	5.36	3.05	-0.89	26.01
FE_bank	1149	3.07	67.41	0	2236.7

4.5 Model estimations

Given the considerations of the theoretical and empirical literature described above, we specify the empirical models to study the relationships between efficiency, bank risk taking, and euroization. In modelling the multiproduct cost function, a translog functional form is adopted. Two outputs, total loans and total investments, and three input prices, the price of labour, the price of borrowed funds and the price of physical capital, are employed.

Control variables are not included as interactive variables in the models so as not to increase the number of the second-order terms in the regression equation. Otherwise they would significantly reduce the degrees of freedom due to the expansion of terms. The control variables included in the model are GDP per capita, Inflation, BSRI, HHI, FO and FE. Time dummies are also included.

The general specification of the translog cost model does not impose a restriction on neutrality, homogeneity or unitary elasticities of substitution. However for a cost function to be well behaved it must satisfy certain conditions. It must be linearly homogeneous in input prices, non-decreasing in output and concave. The homogeneity constraint implies that, for a fixed level of output, total cost must increase proportionally when all prices increase proportionally (Banda and Verdugo, 2008, p.9). The linear homogeneity is imposed by dividing total costs and input prices by one of the factor prices, which is arbitrarily chosen. In the case of equations 4.2 and 4.3 the division by the third input price $\boldsymbol{W3}$.

Symmetry restrictions are required for continuity and this is achieved in estimation by combining the terms which contain the same variables in the cross products of outputs and inputs. In the models specified as equations 4.2 and 4.3 below this means that:

$$\boldsymbol{\alpha_{ik} = \alpha_{ki}} \text{ and } \boldsymbol{\beta_{jm} = \beta_{mj}}$$

We specify two models for estimating cost efficiency initially following Battese and Coelli's 1995 model and then Greene's TRE 2005 model. The following definition of symbols applies to both models:

- $\boldsymbol{TC_{st}}$ is the total cost for the bank $\boldsymbol{s}$ at a time $\boldsymbol{t}$;
- $\boldsymbol{Y_i}$ is the $\boldsymbol{i-th}$ output;

- $\boldsymbol{W_j}$ is the price of the $\boldsymbol{j-th}$ input;
- $\boldsymbol{Z_l}$ is the $\boldsymbol{j-th}$ control variable and
- $\boldsymbol{T_t}$ are the time dummies

1. The BC 1995 model:

$$\boldsymbol{ln\frac{TC_{st}}{W3_{st}} = \alpha_0 + \sum_{i=1}^{2}\alpha_i lnY_{ist} + \frac{1}{2}\sum_{i=1}^{2}\sum_{k=1}^{2}\alpha_{ik}lnY_{ist}lnY_{kst} + \sum_{j=1}^{2}\beta_j ln\frac{W_{jst}}{W3_{st}} + \frac{1}{2}\sum_{j=1}^{2}\sum_{m=1}^{2}\beta_{jm}ln\frac{W_{jst}}{W3_{st}}ln\frac{W_{mst}}{W3_{st}} + \sum_{i=1}^{2}\sum_{j=1}^{2}\delta_{ij}lnY_{ist}lnW_{jst} + \sum_{l=1}^{6}\eta_l Z_{lst} + \sum_{t=2}^{14}\theta_t T_t + v_{st} + u_{st}} \quad \textbf{(4.2)}$$

Where besides the above-defined symbols we have the compound error term which consists of:

- the $\boldsymbol{v_{st}}$ part that corresponds to random fluctuation, and follows a symmetric normal distribution $\left(\boldsymbol{v_i \sim N(0, \delta^2)}\right)$;

  The $\boldsymbol{u_{st}}$ part is the inefficiency component of the error term and its distribution is assumed to be truncated-normal that is independently, but not identically, distributed over different banks. The $\boldsymbol{u_{st}}$ is assumed a function of a set of control variables $\boldsymbol{Z_{lt}}$ and an unknown vector of coefficients. $\boldsymbol{u_{st} = Z_{lst}\delta + C_{st}}$ where $\boldsymbol{u_{st}}$ is truncated-normal distribution with $\boldsymbol{N(0, \delta^2)}$ with point of truncation $\boldsymbol{-Z_{lst}}$, i.e., $\boldsymbol{C_{st} > -Z_{lst}\delta}$.

2. The TRE 2005:

$$\boldsymbol{ln\frac{TC_{st}}{W3_{st}} = \alpha_0 + \sum_{i=1}^{2}\alpha_i lnY_{ist} + \frac{1}{2}\sum_{i=1}^{2}\sum_{k=1}^{2}\alpha_{ik}lnY_{ist}lnY_{kst} + \sum_{j=1}^{2}\beta_j ln\frac{W_{jst}}{W3_{st}} + \frac{1}{2}\sum_{j=1}^{2}\sum_{m=1}^{2}\gamma_{jm}ln\frac{W_{jst}}{W3_{st}}ln\frac{W_{mst}}{W3_{st}} + \sum_{i=1}^{2}\sum_{j=1}^{2}\delta_{ij}lnY_{ist}lnW_{jst} + \sum_{l=1}^{6}\eta_l Z_{lst} + \sum_{t=2}^{14}\theta_t T_t + s_s + v_{st} + u_{st}} \quad \textbf{(4.3)}$$

Besides the initially defined symbols we have the compound error term which in the Greene (2005) model is composed of three parts:

$$\boldsymbol{r_{st} = s_s + v_{st} + u_{st}}$$

- The first part $\boldsymbol{s_s}$ is the random, time invariant, bank specific effect and follows a symmetric distribution $\left(\boldsymbol{s_s \sim N(0, \delta^2)}\right)$;
- The second part $\boldsymbol{v_{st}}$ part that corresponds to random fluctuation, and follows a symmetric normal distribution $\left(\boldsymbol{v_{st} \sim N(0, \delta^2)}\right)$;
- The third part $\boldsymbol{u_{st}}$ is the inefficiency component of the error term which follows a truncated-normal distribution that is independently, but not identically, distributed over different banks. The $\boldsymbol{u_{st}}$ is assumed to be a function of a set of control variables $\boldsymbol{Z_{lt}}$ and an unknown vector of coefficients. $\boldsymbol{u_{st} = Z_{lst}\delta + C_{st}}$ where $\boldsymbol{u_{st}}$ is truncated-normal distribution with $\boldsymbol{N(0, \delta^2)}$ with point of truncation $\boldsymbol{-Z_{lst}}$, i.e., $\boldsymbol{C_{st} > -Z_{lst}\delta}$.

4.6 Empirical results

This section presents the empirical results which are initially structured in two parts. The first part considers the first set of results of both models, BC 1995 and TRE 2005, whilst controlling for the financial euroization at country level and using the large database. The second part discusses the second set of results of both models, BC 1995 and TRE 2005, whilst controlling for financial euroization at bank level using the small database. The discussion in these subsections is then structured into a further three parts: the translog component of the results, the control variables and the efficiency estimates.

Given that our independent variables are composed of individual bank-level (micro-level) and macro county-level variables, applying normal standard errors ignores the multi-level nature of the data and can produce exaggerated statistically significant results particularly for the macro data (Luke, 2004). To deal with this issue we employ robust clustered standard errors. Robust standard errors correct for error correlation across the observations within a cluster, in our case within countries.

They account for a general form of heteroskedasticity as well as for any within country correlation (Primo et al., 2007). Consequently, the robust clustered standard errors are considered more suitable for multi-level structural data such as ours and thus are applied in each set of results.

4.6.1 Financial euroization at country level

This analysis initially explores the relationship between financial euroization at country level and cost efficiencies in banks operating in TEs. Using the models specified in the previous section, we start with estimations where we initially control only for variables that are expected to influence the efficiency frontier, upon which individual banks have no direct control (estimates of 4.2a and 4.3a in the following Tables). Thus, financial euroization at country level and other control variables are explicitly modelled in the efficiency frontier. Then, we estimate the same models but include bank risk variables in the inefficiency component, given that these are factors that banks can control (estimates 4.2b and 4.3b in the following Tables).

Translog and time components

The estimates for these components are given in Table 4.5. The translog component is rarely interpreted in bank efficiency studies in terms of the adequacy of the model specification, given that the large number of interaction terms means that coefficient estimates cannot be individually interpreted. However, these components of the model are highly significant and similar across different model specifications. The negative impact of the time dummies reflects the downwards shift in the cost frontier over time, which would be expected with technology improvements. With a more advanced technology available, banks are able to cut their costs each year. The two years in which the impact of the time dummies is positive corresponds to the years when the effect of global financial crisis reached these countries (2009 and 2010).

Table 4.5 The results for the translog component[5]

	BC 1995 4.2a		BC 1995 4.2b		TRE 2005 4.3a		TRE 2005 4.3b	
lnTC	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
lnY1	**0.391*** **	0.000	**0.903*** **	0.000	**0.205** **	0.025	**0.836*** **	0.000
lnY2	**0.302*** **	0.000	**0.128*** **	0.000	**0.343*** **	0.000	**0.131*** **	0.000
lnW1	**0.875*** **	0.000	**0.952*** **	0.000	**0.860*** **	0.000	**0.979*** **	0.000
lnW2	-0.007	0.852	0.001	0.973	**-0.070** **	0.056	-0.052	0.160
lnY1lnY2	**-0.043*** **	0.000	**-0.018*** **	0.000	**-0.045*** **	0.000	**-0.016*** **	0.000
lnW1lnW2	**0.039*** **	0.000	0.040	0.000	**0.031*** **	0.000	**0.029*** **	0.000
half_lnY1lnY1	**0.075*** **	0.001	**0.016** **	0.023	**0.084*** **	0.000	**0.016*** **	0.000
half_lnY2lnY2	**0.033*** **	0.000	**0.016*** **	0.000	**0.031*** **	0.000	**0.013*** **	0.000
half_lnW1lnW1	-0.0007	0.937	-0.002	0.687	0.0004	0.964	0.002	0.726
half_lnW2lnW2	**-0.036*** **	0.000	**-0.037*** **	0.000	**-0.029*** **	0.000	-0.028	0.000
lnY1lnW1	0.004	0.735	-0.007	0.598	-0.006	0.469	**-0.019** **	0.036
lnY1lnW2	**0.013*** **	0.001	**0.014*** **	0.002	**0.018*** **	0.000	**0.016*** **	0.000
lnY2lnW1	**-0.012*** **	0.000	**-0.005*** **	0.000	**-0.007*** **	0.000	**-0.002** **	0.025
lnY2lnW2	**0.008*** **	0.000	**0.006*** **	0.000	**0.005** **	0.022	**0.005*** **	0.001
T2	-0.076	0.366	-0.079	0.278	-0.056	0.306	-0.069	0.202
T3	**-0.246** **	0.038	-0.164	0.131	**-0.196** **	0.044	-0.164**	0.034
T4	**-0.286** **	0.030	-0.157	0.213	**-0.201** **	0.039	-0.183**	0.026
T5	**-0.454*** **	0.003	**-0.280** **	0.038	**-0.262** **	0.014	-0.216***	0.007
T6	**-0.449*** **	0.003	**-0.272***	0.078	**-0.333** **	0.005	-0.272***	0.002
T7	**-0.524*** **	0.001	**-0.329** **	0.033	**-0.388** **	0.005	-0.337***	0.001
T8	**-0.593*** **	0.001	**-0.403*** **	0.008	**-0.436** **	0.012	-0.399***	0.001
T9	-0.174	0.236	0.009	0.951	-0.178	0.248	-0.119	0.289
T10	0.0010	0.999	0.130	0.510	0.001	0.991	0.051	0.686
T11	**-0.245***	0.102	-0.111	0.491	-0.176	0.194	-0.157	0.121
T12	**-0.265***	0.104	-0.096	0.559	-0.120	0.432	-0.113	0.320
T13	**-0.311** **	0.042	-0.147	0.357	-0.157	0.289	-0.156	0.165
T14	**-0.314** **	0.048	-0.147	0.357	-0.171	0.276	-0.156	0.165
No of obs	9930		9599		9930		9599	
No of groups	1401		1365		1401		1365	

Statistics with *, **, or *** are significant at 10%, 5%, or 1% level, respectively.

Control variables

In the context of the thesis, the results of the control variables are of main interest particularly those of financial euroization and the risk variables. The regression results for these variables are summarized in Table 4.6

[5] Refer to Appendices 4.2 and 4.3 for STATA outputs

Table 4.6 Control Variables results[6]

	BC 1995 4.2a		BC 1995 4.2b		TRE 2005 4.3a		TRE 2005 4.3b	
lnTC	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
Variables introduced in the efficiency frontier								
GDP_c	-0.00001	0.117	**-0.00001****	0.038	-0.00001	0.248	-0.00001	0.129
Inf	-0.001	0.619	0.0005	0.846	0.001	0.265	0.001	0.178
BSRI	0.074	0.379	**0.120***	0.107	**0.225*****	0.001	**0.223*****	0.000
FO	**-0.253***	0.071	**-0.366****	0.005	-0.009	0.943	-0.139	0.180
HHI	-0.0004	0.193	-0.00003	0.205	-5.37e-	0.718	-6.52e-	0.611
FE_sector	**0.354*****	0.012	**0.334****	0.022	**0.555*****	0.000	**0.501*****	0.000
Variables introduced in the inefficiency component								
CR	-	-	**0.076*****	0.000	-	-	**0.044*****	0.000
OR	-	-	**-0.297*****	0.000	-	-	**-0.065*****	0.000
MR	-	-	**-0.089*****	0.000	-	-	-0.008	0.692
No of obs	9930		9599		9930		9599	
No of groups	1401		1365		1401		1365	

*Statistics with *, **, or *** are significant at 10%, 5%, or 1% level, respectively.*

The estimate for the coefficient associated with financial euroization (FE_sector) is highly significant with a positive sign in all model specifications. The level of euroization is expected to affect the frontier and the positive sign of the estimate indicates banks operating in countries with higher financial euroization tend to face higher costs. As discussed in section 2.5.3, the specific relationship between financial euroization and bank efficiency has not been previously explored, thus there are no grounds for comparison. However, the relationship between euroization and other financial sector performance indicator has been explored empirically. Nevertheless as, explained in section 2.5.3, this literature is limited and has not reached a consensus on the nature of the relationship between financial euroization and financial sector performance, although it leans more towards a negative relationship. Thus, our results are in line with a part of empirical literature.

Regarding the risk variables, credit risk (CR), operational risk (OR) and market risk (MR), the estimates for the coefficients of all variables (CR, OR and MR) are highly significant in both models with the exception of market risk in the TRE 2005 model. Given that the risk variables are introduced in the inefficiency component, they affect inefficiency directly. The estimates have consistent signs across the models. The

[6] Refer to Appendices 4.2 and 4.3 for STATA outputs

coefficient of credit risk variables has a positive sign suggesting that on average a higher credit risk increases banks' inefficiency, i.e. decreases efficiency. The estimated coefficients of operational and market risk are negative, indicating a negative impact on inefficiency thus a positive impact on cost efficiency. Theoretically, risk variables are expected to have a negative relationship with bank efficiency, thus the opposite sign for two of our risk variables is surprising.

With regard to other control variables, in terms of statistical significance the results are not fully consistent across the BC 1995 model specifications, but highly consistent across the TRE 2005 specifications. In the first BC 1995 model (4.2a), besides euroization, only foreign ownership (FO) is significant (and then only at the 10% level) and has a negative sign. In the second BC 1995 specification (4.2b), foreign ownership has the same sign but a level higher significance and size, suggesting that the higher the degree of foreign ownership in banking sector the higher the costs that banks face. However, the variable is insignificant in both TRE 2005 estimations (4.3a and b). These results are perhaps not surprising given the existing empirical literature is inconclusive on the relationship between foreign ownership and bank efficiency.

The BSRI variable is significant with a positive sign in models 4.2a, 4.3a and 4.3b. A priori it was expected that in the more reformed sectors banks would be more efficient; however, given that here we introduce BSRI in the frontier its impact is directly related to the frontier rather than efficiency. Our results suggest that banks in more reformed banking sectors face higher costs, which might be reasonable given that in more reformed sectors the regulatory requirement might be higher. In the 4.2b BC 1995 specification, GDP per capita is also significant with a negative sign, suggesting that in more developed economies banks face less costs, which is in line with previous expectations.

Properties of cost inefficiencies

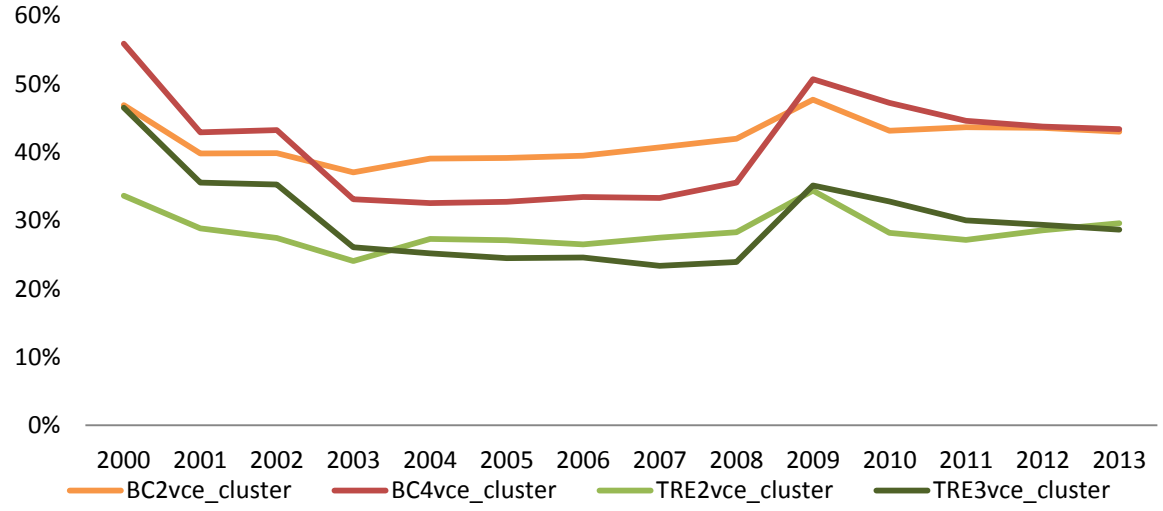
Although individual bank efficiency estimates are not of main interest in the thesis, we analyse their trend across different models over time and in relation to different control variables. The average measured cost inefficiency of all banks and their descriptive statistics in the 2000-2013 period are presented in Table 4.7.

Table 4.7 Descriptive statistics of inefficiency scores

Year	BC 1995 4.2a	BC 1995 4.2b	TRE 2005 4.3a	TRE 2005 4.3b
2000	0.469	0.559	0.336	0.465
2001	0.398	0.429	0.288	0.356
2002	0.398	0.432	0.274	0.353
2003	0.371	0.331	0.241	0.261
2004	0.391	0.326	0.273	0.252
2005	0.391	0.327	0.271	0.245
2006	0.395	0.335	0.265	0.246
2007	0.407	0.333	0.275	0.233
2008	0.420	0.356	0.283	0.239
2009	0.477	0.507	0.344	0.351
2010	0.431	0.472	0.282	0.328
2011	0.437	0.446	0.271	0.300
2012	0.435	0.437	0.285	0.294
2013	0.430	0.434	0.296	0.286
Mean	0.422	0.404	0.284	0.285
St. deviation	0.303	0.448	0.243	0.396
No of obs	9930	9599	9930	9599
No of groups	1401	1365	1401	1365

Consistent with earlier studies, the results show that the mean cost-inefficiency score for banks in TEs ranges from 28 to 42 percent across different specifications. The mean annual inefficiency scores over the period across different specifications is shown in Figure 4.1.

Figure 4.1 Annual average bank inefficiency, 2000-2013



BC2vce_cluster= average inefficiency scores of the BC 1995 4.2a model; **BC4vce_cluster= average inefficiency scores of the BC 1995 4.2b model; **TRE2vce_cluster** = average inefficiency scores of the TRE 2005 4.2a model; **TRE3vce_cluster** = average inefficiency scores of the TRE 2005 4.2b model.*

The Figure 4.1 shows that the inefficiency scores obtained from using TRE 2005 model are lower in comparison to the BC 1995 model. This is not surprising given that the TRE model treats the unobserved bank-specific random effects separately

from inefficiency (Greene, 2005). Given that BC 1995 model is the most frequently used model in the literature our results suggest that cost inefficiencies found by these studies might be overestimated.

Regarding the development of inefficiency over time, the Figure 4.1 shows that the average inefficiency score is the highest in the initial years in all specifications and is decreasing up until 2004. From 2004 it remains relatively stable for few years to 2009 when it increases. The latter deterioration could be the result of the global financial crisis of 2008 because TEs were affected with a delayed indirect impact. The increased inefficiency during these years would be expected because banks tend to have higher operating costs after such a crisis, usually due to the more stringent policies imposed by the monetary authorities to stabilize the banking system. In addition, banks may not have the necessary flexibility to adjust their inputs amid decreasing outputs as loan demand may drop sharply (Kwan, 2006). After a while banks adapt and reach lower inefficiency levels. Thus, the results indicate changes in the efficiency of banks in TEs during the period, justifying the time variance specification.

4.6.2 Financial euroization at bank level

In the second part of the analysis in this chapter we explore the relationship between financial euroization at bank level and cost efficiencies in banks operating in TEs. Here, as in the previous subsection, cost efficiency is estimated through the Battese and Coelli (1995) and Greene TRE (2005) models using various control variables. However, contrary to the first part here financial euroization at bank level is modelled in the inefficiency component of the error term because it is expected to affect the distance of individual banks from the frontier rather than the position of the frontier.

Translog and time components

The regression results of the translog components are summarized in Table 4.8. The TRE 2005 model specification (4.3b), with risk variables in the inefficiency component, we could not estimate due to the smallness of the sample size given the complexity of the model. The results for the other three models are considered but

should be interpreted with caution, given this issue. Contrary to the previous section, here the results of the translog components are not fully consistent across different estimations in terms of significance and sign. The technological improvement is documented through the negative sign of time dummies in the BC 1995 models but not with the TRE 2005 models.

Table 4.8 The results for the translog components[7]

	BC 1995 4.2a		**BC 1995 4.2b**		**TRE 2005 4.3a**	
lnTC	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
lnY1	0.243	0.682	0.778	0.126	**0.166****	0.095
lnY2	0.479	0.063	0.247	0.194	**0.480*****	0.000
lnW1	**1.361*****	0.003	**1.394*****	0.001	1.164	-
lnW2	-1.466	0.822	-0.330	0.511	-0.123	-
lnY1lnY2	**-0.567****	0.035	-0.033	0.138	**-0.051*****	0.001
lnW1lnW2	**0.200*****	0.000	**0.224*****	0.000	0.155	-
half_lnY1lnY1	0.084	0.174	0.026	0.604	**0.076*****	0.001
half_lnY2lnY2	**0.042****	0.007	**0.036****	0.015	0.032	-
half_lnW1lnW1	**-0.162****	0.016	**-0.213*****	0.000	-0.130	-
half_lnW2lnW2	-0.141	0.134	**-0.147****	0.079	**-0.123*****	0.000
lnY1lnW1	-0.062	0.217	**-0.082****	0.063	**-0.060*****	0.000
lnY1lnW2	0.046	0.451	**0.078***	0.102	0.037	0.247
lnY2lnW1	0.0001	0.995	0.010	0.626	0.001	0.898
lnY2lnW2	0.0145	0.638	0.0005	0.984	0.015	0.713
T2	**0.150****	0.043	**0.235****	0.013	0.139	0.503
T3	-0.087	0.334	0.020	0.800	0.028	0.917
T4	**-0.263***	0.101	-0.180	0.125	-0.037	0.906
T5	**-0.313****	0.012	**-0.229****	0.022	-0.052	0.855
T6	**-0.325****	0.013	-0.229	0.022	-0.020	0.948
T7	**-0.301****	0.020	**-0.196****	0.061	0.051	0.859
T8	**-0.321****	0.022	**-0.220****	0.058	0.102	0.742
T9	**-0.328****	0.030	-0.214	0.124	0.081	0.808
T10	**-0.309****	0.012	**-0.228****	0.016	0.100	0.727
T11	**-0.357****	0.012	**-0.279****	0.010	0.040	0.897
T12	**-0.453****	0.012	**-0.366****	0.012	0.045	0.901
T13	**-0.455****	0.009	**-0.378*****	0.005	0.037	0.916
T14	**-0.473****	0.023	**-0.404****	0.018	0.028	0.942
No of obs	1001		971		1001	
No of groups	119		118		119	

Statistics with *, **, or *** are significant at 10%, 5%, or 1% level, respectively.

[7] Refer to Appendices 4.4 and 4.5 for STATA outputs

Control variables

The estimates of the effects of the control variables are summarized in Table 4.9.

Table 4.9 Control variable results[8]

	BC 1995 4.2a		BC 1995 4.2b		TRE 2005 4.3a	
lnTC	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
Variables introduced in the efficiency frontier						
GDP_c	**-9.336e-****	0.047	**-9.33e-***	0.109	**-0.00001****	0.003
Inf	**0.013****	0.027	0.009	0.151	**0.010****	0.085
BSRI	**-0.185****	0.013	-0.169	0.009	0.008	0.935
FO	**0.509*****	0.000	**0.504*****	0.000	0.004	0.983
HHI	-0.00002	0.505	-0.00002	0.473	0.00005	0.315
Variables introduced in the inefficiency component						
FE_bank	-0.251	0.584	0.129	0.710	0.602	0.429
CR	-	-	0.008	0.619	-	-
OR	-	-	-0.002	0.796	-	-
MR	-	-	-	-	-	-
No of obs	1001		971		1001	
No of groups	119		118		119	

Statistics with *, **, or *** are significant at 10%, 5%, or 1% level, respectively.

The estimate of the effect of financial euroization at bank level (FE_bank) is not significant in any of the specifications. There is no evidence that inefficiency is affected by banks' choices on the share of foreign currency loans in their portfolio. The risk variables are also insignificant across specifications. One possible reason for this may be the relatively small sample size given that the translog functional form is considered more appropriate for large samples and may suffer from multicollinearity with small samples which can lead to high standard errors of regression coefficients (Cohen and Gujarati, 1970).

There are some inconsistencies across specifications in the results for other control variables. In all specifications, GDP per capita is significant with a negative sign, suggesting that in more developed economies banks face less costs, which is in line with previous expectations. Inflation is significant in the first BC 1995 model and the TRE 2005 model with a positive sign suggesting that higher inflation increases costs banks face. Foreign ownership is also significant in BC 1995 models with a positive

[8] Refer to Appendices 4.5 and 4.6 for STATA outputs

sign suggesting that higher degree of foreign ownership increases the costs bank face. The BSRI variable is significant only in the first BC 1995 model and has a negative sign, suggesting that in the more reformed banking sectors banks face lower costs.

Properties of cost inefficiencies

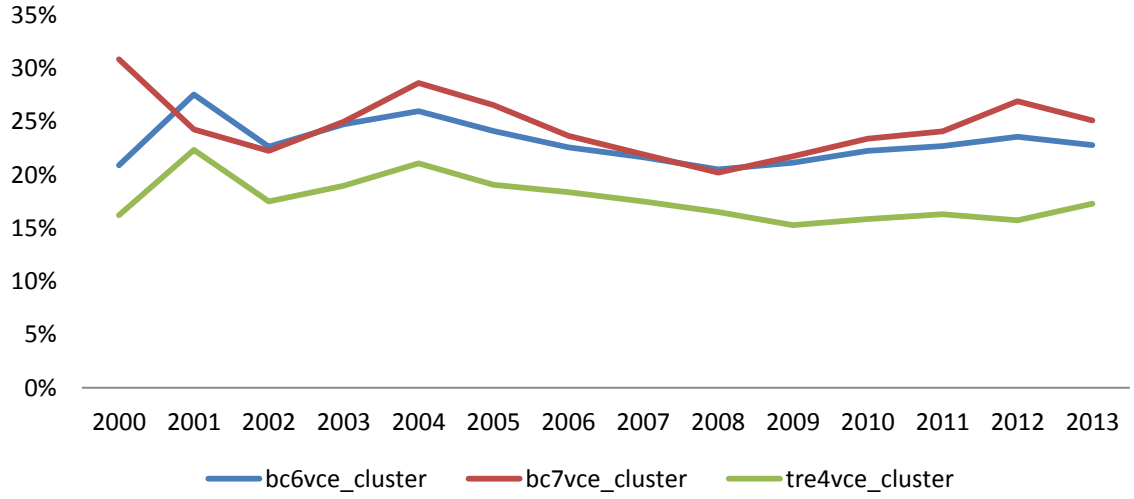
The average measured cost inefficiency of all banks across different specification throughout the period 2000-2013 and their descriptive statistics are presented in Table 4.10.

Table 4.10 Descriptive statistics of inefficiency scores

Year	**BC 1995 4.2a**	**BC 1995 4.2b**	**TRE 2005 4.3a**
2000	0.209	0.309	0.162
2001	0.276	0.243	0.223
2002	0.226	0.223	0.175
2003	0.247	0.250	0.190
2004	0.260	0.286	0.211
2005	0.241	0.266	0.191
2006	0.226	0.237	0.184
2007	0.216	0.219	0.175
2008	0.205	0.202	0.165
2009	0.211	0.217	0.153
2010	0.222	0.234	0.158
2011	0.227	0.241	0.163
2012	0.236	0.269	0.157
2013	0.228	0.251	0.173
Mean	0.227	0.241	0.171
St. deviation	0.156	0.202	0.152
No of obs	1001	971	1001
No of groups	119	118	119

On average, over the period banks' costs exceed the minimum level frontier from 17 percent up to 23 percent depending on the model. Here as well, considerable differences are found in the estimates of inefficiency scores between the models, with the TRE 2005 model producing lower scores. This is documented in Figure 4.2 as well where the annual average inefficiency score across different specifications over the period is depicted.

Figure 4.2 Annual average bank inefficiency, 2000-2013



BC6vce_cluster= average inefficiency scores of the BC 1995 4.2a model; **BC7vce_cluster= average inefficiency scores of the BC 1995 4.2b model; **TRE4vce_cluster** = average inefficiency scores of the TRE 2005 4.3a model.*

Figure 4.2 shows that the inefficiency scores produced by the TRE 05 model are lower than those of BC 1995. As argued in section 4.6.1 this is not surprising since the model treats the unobserved bank-specific random effects separately from inefficiency. The Figure shows that the inefficiency is more volatile in the initial years of the period under consideration, which is not surprising given that these years mark beginning of the second decade of the transition process. From 2004 inefficiency is decreasing across all models until 2008-2009. In the BC 1995 models the trend reverses and inefficiency increases reaching a peak in 2012). The deterioration could be attributed to the delayed impact of the global financial crisis and difficulties in the Euro Area in 2011. However, the inefficiency estimates from the TRE 2004 model (4.3a) there is little change over this period. Thus, overall the results indicate changes in the efficiency of banks in TEs during the period, justifying the time variance specification.

4.7 Conclusions

The literature review on euroization and bank efficiency, presented in Chapters 2 and 3, showed that the existing literature completely neglects the impact of euroization on bank efficiency and that the bank efficiency literature in TEs has been limited in its exploration of the risk-return aspect associated with banks' operations, in spite of its increasing importance. The aim of this chapter was to address these gaps through

empirical exploration of the relationship between financial euroization and bank efficiency in TEs. The investigation is conducted estimating cost efficiency of banks operating in TEs, whilst controlling directly for the impact of financial euroization. Furthermore, the investigation explores the risk-return dimension in the context of bank efficiency, an under researched area by controlling for the impact of different risks on bank efficiency. In addition, by covering an extended period from 2000 to 2013 (14 years), the investigation considers more data than has been available previously, hence broadening the previous bank efficiency literature.

The investigation is carried out using a stochastic frontier approach (SFA) for estimating the cost efficiency. The use of SFA enables the inclusion of the financial euroization and risk factors explicitly in the efficiency estimation instead of the two-step approach which are criticized in the literature for being persistently biased. Two different time varying efficiency models are employed for efficiency estimations, the Battese and Coelli 1995 and Greene TRE 2005, the first is the most frequently used model in the literature whereas the second is used more rarely but is much more flexible. These models differ with respect to how they let the efficiency vary and, by using them both, we are able to compare and draw on the strengths of both. The results showed that the inefficiency scores obtained through TRE 2005 are consistently lower than those of BC 1995. Although, this is not very surprising given that the TRE model separated the effect of the unobserved bank-specific random effects from inefficiency, it does suggest that the previous literature that has employed the BC 1995 model might have overestimated the degree of bank inefficiency.

The impact of financial euroization on bank efficiency is explored by controlling for the impact of euroization at both country and bank levels. We found evidence that financial euroization at country level affects the cost efficiency that banks can achieve in TEs. The results of this investigation are very similar in terms of the sign, size and significance of the coefficients of financial euroization across different model specifications and estimation techniques. They suggest that in countries with higher degree of financial euroization banks face higher costs. However, with regard to euroization at the bank level we found no evidence that it has any effect on banks' efficiency. However, this might be the result of our sample size, despite our considerable effort in obtaining the data for this investigation.

Regarding the risk aspect, estimates of operational and market risk are significant and suggest a negative impact of risk on cost efficiency, which is in line with previous expectations. Thus, the study has found evidence that different risks affect the cost efficiency that banks operating in TEs can achieve. In addition, the study found evidence of changes over time in cost efficiency in banks TEs, justifying the use of time variant specification when using longer time spans in estimating efficiency. Finally the study also found evidence that GFC did increase minimum costs that banks in TEs faced, and this looked that it might have been a short term problem, given that banks managed to adjust rapidly in terms of cost efficiency.

Chapter 5

An exploration of financial euroization at bank level: A qualitative analysis

5.1 Introduction

The aim of this chapter is to investigate the financial euroization phenomenon in depth, through a qualitative investigation. Building on the previously conducted quantitative research presented in Chapter 4, where we investigated the implications of financial euroization and related risks for bank efficiency, we now turn to qualitative analysis to further explore and better understand the phenomenon of financial euroization through banks' lenses. We do so because employing qualitative and quantitative research methods as complementary strategies in addressing the same research area and thus drawing on the respective strength of each method within the research design can provide a more complete understanding of the phenomenon (Bryman, 2006; Gilbert, 2008; Silverman, 2011).

This investigation uses semi-structured face-to-face interviews carried out in the natural settings of individual banks operating in two SEE countries (Albania and Macedonia). By doing so, we are able to explore different viewpoints and mechanisms or linkages related to financial euroization, enabling a deeper understanding of the phenomena (Maxwell, 1996; Healy and Perry, 2000). The focus will be on deepening our understanding about financial euroization through banks' perspectives so that policy-makers, strategy developers, regulatory authorities and academic communities will be more conscious of how individual banks address financial euroization. Although the degree of financial euroization, defined as loans and deposits in foreign currency, remains relatively high in these banks (as discussed in section 1.3), its investigation has been ignored in the qualitative research literature. Given the lack of such literature on financial euroization, to the best of the author's knowledge, this study breaks new ground with the potential for making a contribution to understanding aspects of the euroization phenomenon. In addition, the study contributes to the qualitative literature by identifying themes and conceptual frameworks related to financial euroization that could be further examined in future studies.

The rest of the chapter is structured in the following manner. In section 5.2 the purpose of the analysis and the research question are explored. Next, in section 5.3 the ethical considerations relevant to the nature of the study are identified, with emphasis on the issue of confidentiality and strategies employed to maintain it. The discussion on the design and methodology of the overall qualitative approach is

presented in section 5.4. Subsequently, the procedures for data collection and analysis are detailed in sections 5.5. and 5.6 respectively. Next, the issue of validity and reliability of the study is elaborated in section 5.7. A summary of the financial setting in Albania and Macedonia is presented in section 5.8. The main findings and the discussion of the findings and their implications are presented in sections 5.9 and 5.10 respectively. The final section concludes the chapter.

5.2 Purpose of the analysis

The primary purpose of this qualitative study is to explore financial euroization through individual banks' lenses. The goal is to make a deeper investigation of the general strategies and specific policies and procedures employed by banks to address financial euroization.

The analysis in this chapter addresses the third key research question of the thesis, presented in section 1.2:

What do banks regard as the main determinants of euroization? What are their strategies, policies, and procedures with regard to euroization? Do they feel that euroization affects their efficiency?

In relation to this, the following research sub-questions are devised to guide the investigation in this chapter. They are considered of importance because we lack knowledge regarding the nature of financial euroization management processes that take place within banks operating in SEE. Without this knowledge, we are in poor position to understand, assess or improve policies addressing FE.

> *What is your strategy with regard to financial euroization? What factors influence the need for and nature of the foreign currency (FC) strategy? Does it vary with bank characteristics?*

In relation to this first set of questions, this investigation does not attempt to create a typology of various types of FC strategies employed by banks, because such an attempt would require an unambiguous classification of types of FC strategies. It is more concerned with whether the FC strategy is centrally managed i.e. at the level of group headquarters or not. In addition, the study attempts to identify the factors that influence the FC strategy employed by banks in the study.

What are the procedures and processes employed by the banks to address the risks related to financial euroization? Do these vary between banks and over time?

Through this second set of questions, this investigation attempts to investigate the design and functioning of the instruments, procedures and processes employed by banks in addressing risks related to FE. The focus is on how the specific instruments are used to manage FE risk and whether they are set at the group headquarters or at the individual bank.

What are the drivers of FC lending? Do they vary between banks and over time?

With regard to this third set of questions, this inquiry is focused on factors that can explain the high degree of FC lending in these banks, and countries. The interdependence among factors is considered of great importance and explored.

5.3 Ethical considerations

Attention to ethical considerations throughout all types of research is being increasingly recognized as essential (Denzin and Lincoln, 2000; Fine et al., 2000; Maxwell, 2008). However, in qualitative research ethical considerations are distinctive compared to quantitative research, mainly due to the flexible research design and the unstructured data collection applied in qualitative literature (Hammersley and Traianou, 2012). Informed consent, use of information and confidentiality are the main issues that ought to be anticipated and planned for when conducting qualitative research (Lipson, 1994; Kvale, 1996; Hatch, 2002; Lincoln, 2009; Mertens and Ginsberg, 2009; Creswell, 2012). The above-mentioned ethical issues were considered throughout different stages of the investigation in this chapter, from the early design stage through to the findings to maintain the validity and reliability of the research. The study was approved by the Faculty Ethics Committee at Staffordshire University.

The issue of gaining access to the interviewees and banks is a challenge that arises right at the beginning of research when initiating the first contact with the participants. Convincing individuals to participate in the study by building trust and credibility is an access challenge relevant to this investigation, given the sensitive nature of the banking data. When dealing with sensitive issues, access to participants

is easier through an intermediary or gatekeeper, an individual who leads the researcher to participants (Hammersley and Atkinson, 1995) and this investigation employed that approach, initially contacting participants through intermediaries. This additional layer can lead to added ethical considerations such as misinformation about the nature of research or coercion, the pressuring participants into participating in the study. To avoid any sort of miscommunication with regard to the study, the gatekeepers were a priori informed in detail regarding the research and interview procedure and were provided with a statement letter written in plain language (Appendix 5.1) about the research project and the interview questions (Appendix 5.3) to pass on to the to the designated participants. With regard to the issue of coercion, the gatekeeper was clearly instructed not to put any form of pressure on the participants with regard to taking part in the interview.

The informed consent, as one of the principal aspects of ethical considerations in qualitative research, was another ethical issue considered relevant to this investigation. The informed consent mainly entails informing the participants in good time about the purpose and intent of the study, the questions they will be asked, and giving them the opportunity to make a decision about whether or not to take part in the study. Participants should also be provided with the possibility of withdrawing later, because by doing so, the researcher will "minimize the possibility of coercion or undue influence" (Hatch, 2002, p. 63). In the relationship with participants in this investigation, the author communicated the purpose and intent of the study through a statement written in plain language, an informed consent form, and the actual interview questions, in advance (Appendix 5.1, 5.2, 5.3). Therefore, each participant was sufficiently informed about the purpose and intent of the research to be able to make informed decisions regarding their voluntary involvement. The participants indicated consent by signing the consent form, which acknowledges their voluntary participation in the research. In addition, it was made clear to all participants that should they wish to withdraw at any stage, or to withdraw any information or data which they have supplied to the author, they are free to do so without prejudice.

The possible consequences of participating in a research project for interviewees must be always taken into account when conducting interviews. The main ethical issues consist of identifying and addressing potential risks for the participants. In this study there were no associated risks other than the normal social/emotional risks of

being interviewed, and participants were notified of this fact. In addition, every participant was asked to contact the research supervisors if any concerns arose regarding the conduct of the project which they do not wish to discuss with the researcher.

Confidentiality was the central ethical issue anticipated in this investigation, given the sensitive nature of banking data: financial euroization data is considered 'sensitive information' by banks, thus participants had to be assured that the information provided by them about their individual banks, as well as the identity of their bank, will remain confidential. Confidentiality, as an ethical issue, involves protecting the privacy of subjects in a study through changing, or not mentioning names and any information that makes it possible to identify them (Kvale, 1996). In this study the participants were given explicit assurance through a statement written in plain language that the study will protect their anonymity and the confidentiality of their responses to the fullest possible extent, within the limits of the law. They were assured further that their name and contact details and the name of the institution they represent would be kept in a separate, password-protected computer file separate from any file containing the information that they supplied. The participants were assured that they would not be asked for any quantitative data regarding financial euroization. The qualitative data given would only be linked to their responses by the author, for the purpose of verification and checking. In the thesis, and in any publications arising from the research, their names and the name of the institution they represent will be referred to by a pseudonym. Any references to personal information that might allow someone to guess their identity will be removed.

In addition, background details (including statistical background) will not be presented in this chapter because it could possibly lead to identification of the participants, given the small banking sectors in these countries. This will limit the scope of the study because it is impossible to make specific comparisons given the relatively small sizes of the economies in the countries in the research without disclosing the institutions' identities. The data will be kept securely for five years from the date of publication, before being destroyed. The ethical dimension of the use of information consists of data obtained through interviews not being used for other research. Regarding the use issue, the participants were assured explicitly that the

data collected is for the sole purpose of this academic research and only accessed by the author.

The issue of undue intrusion, which consists of avoiding approaches that place an undue burden on participants (Creswell, 2012) is an important consideration when dealing with human participants. In line with this, the author did not burden participants with quantitative data regarding financial euroization, to avoid 'putting them on the spot' given that they are considered sensitive information by banks. Throughout the interview, the author avoided questions and discussions on issues that could be obtained elsewhere. In addition, the author tried and succeeded in conducting each interview within 45 minutes, thus not exceed the 60 minutes as promised.

Reciprocity is an additional ethical issue that must also be taken into account when using human participants as means of collecting qualitative data. Whilst benefits for the researcher are easily identified, benefits for participants are not always obvious: thus, the researcher should clarify how the research will contribute to the participants or their organization (Hatch, 2002). In this investigation, the author continuously treated participants with dignity and respect and most importantly generated a trusting ambience. With regard to giving back something of substance, as Hatch stresses, the participants were offered a short summary of the results of the study, should they wish to have them as a benefit of participating in the study.

5.4 Design and methodology

This section starts by considering the rationale for the research method and goes on to consider the details of the design.

5.4.1 The rationale for the approach of semi-structured interviews

Initially a case study approach was considered the most appropriate methodological approach to address the research sub-questions. The case study approach utilizes multiple sources of information, rich in context, which could be used to examine the various dimensions of financial euroization and related risks (Yin, 2003). However, conducting a case study method was not viable without disclosing the identity of the participants and the banks they represent. For instance, the presentation of bank-

level statistical information, or even detailed background qualitative data on the individual banks connected to the individual interviews could have led to possible identification of the participants. Therefore, we were constrained into using only semi-structured in-depth interviews, using background information only to examine the banks as groups, which did not compromise the confidentiality of the participants.

The underlying assumption of the study is that the participants would provide honest answers throughout the interviews. In being careful with the ethical considerations and other aspects of the design of the study we hoped to encourage the interviewees to do this.

5.4.2 Role of the researcher

In qualitative research, the researcher is an instrument "in much the same way that a sociogram, rating scale, or intelligence test is an instrument" (Leddy and Ormrod, 2005, p.133). The role of the researcher consists of creating a comfortable atmosphere for the participants, understand them objectively and protect their confidentiality. To fulfil this role in this investigation, the author adapted to participants' requests with regard to interview settings and consistently made sure they felt at ease.

Aiming for objectivity and comparability of the responses, the author asked the same questions in all interviews. The author did not lead the participants. There was no bias from forcing participants to focus only on positive or negative issues: they could, and did, bring up both. To ensure confidentiality and consistency the author was the only person conducting the interviews and analysing the collected data.

5.4.3 Sample selection

In qualitative research, the norm is to use non-random sampling which consists of two types: convenient and purposeful (Trochim, 2001). Non-random convenient sampling involves using easily accessible sample. This investigation employs non-random purposeful sampling, which occurs when the sample is chosen in accordance to specific characteristics of the population studied. The criteria are usually defined theoretically or strategically to create a deeper understanding around the topic of interest. The sample consists of participants who can best inform the research about

the phenomenon studied, selected within the general population, to whom the findings are generalized (Trochim, 2001; Leedy and Ormrod, 2005; Creswell, 2007). Miles and Huberman (1994) identify and elaborate on approximately 16 theoretical driven sampling strategies that are applied in qualitative research literature. Later, Creswell (2007) analyses their application in qualitative literature and lists maximum variation; specific criterion; critical cases and convenient cases, which are applied in this study as the most popular strategies. Maximum variation consists of selecting individuals and/or sites that are quite different based on the criteria selected, to increase the likelihood that the findings will reflect the differences or different perspectives. Critical cases strategy consists of selecting individuals and/or sites which provide specific information about a problem, whereas, convenience cases consists of selecting the individuals and/or sites which the researcher can easily access (Creswell, 2007).

Sampling can be at the site level, the event/process level, and at the participant level, and one or more levels ought to be present for a better sample (Marshall and Rossman, 2006; Creswell, 2007). In selecting the sample for this investigation, three levels were identified:

- Countries
- Banks
- Participants

The nature of the research meant that Albania, Macedonia, and Serbia were countries of interest first, because they are geographically located in South-eastern Europe, which is the focus of this thesis. Second, they all have their own currencies and are significantly euroized. Third, they differ in terms of their financial systems, exchange rate regimes, and economies in general, which may affect perceptions regarding financial euroization and related risks. Thus, information obtained ought to be more richly, textured and thus more informing regarding the focus of the study: financial euroization. For practical reasons, banks in Serbia were not pursued: the researcher was not able to travel to Serbia or arrange interviews with any bank. Kosovo was also considered for comparative purposes as an extreme case - a country without a currency of its own. However, banks in Kosovo were dropped from the study because,

following two interviews, it became clear that in both cases the use of any currency other than euro was either zero or negligible.

In selecting the banks, three screening criteria were employed to ensure selected banks are representatives of the diversity of the banking systems:

- Size
- Ownership
- Convenience

With regard to size, banks of different sizes were targeted to increase the likelihood that the findings will reflect differences in terms of strategies, policies, and procedures with regard to financial euroization. Thus, the sample consists of large and small banks, currently operating in Albania and Macedonia. Over half of the sample consists of large banks (Table 5.1).

Table 5.1 Bank Characteristics

Sample size	Banks in Albania	Banks in Macedonia	Foreign owned	Large banks	Small banks
7	5	2	7	4	3

Source: own calculation

Regarding ownership, the banks selected were all foreign owned, although to different degrees. Most of the banks in these countries are foreign owned (see section 1.4) and for ethical reasons we cannot identify further details.

Convenience or ease of access was an additional criterion applied in sample selection for this study. The nature of the research, given that financial euroization is considered sensitive bank data, made accessibility to banks a challenge to the study. Although, the participants were not asked for quantitative data regarding the share of financial euroization, the sensitive nature of bank specific strategies, policies and procedures limited us to target banks where we had sufficient connections to gain access. Nevertheless, it must be highlighted that all banks that we approached, with exception of one, responded positively.

The targeted participants in each bank are persons responsible for the risk operations of their banks. These include chief risk managers, risk managers and

credit risk managers. Including persons at different levels of seniority in the sample enabled exploration of the phenomenon through different layers of responsibilities. The sample included different levels of seniority of bank representatives, which for the sake of confidentiality we are calling risk managers. The overall sample included one senior manager, four middle managers, one operational manager, and one non-manager senior risk officer (Table 5.2).

Table 5.2 Respondent Characteristics

Sample size	Male	Female	Seniority level		
			High	Medium	Low
7	4	3	1	5	1

Source: own calculations

We focused largely on middle management because it was expected they would be the persons more informed regarding the policies and procedures of the bank as well as the general strategies. However, we made sure to include a more senior manager to have the perspective of the higher management who are also more responsible for the general strategies of the banks. Operational managers were expected to be knowledgeable on specific risk procedures; while a non-management senior risk officer was expected to be more informed regarding the technical details of their bank's operations.

In qualitative research, the sample size is a matter of judgment. The focus of purposeful sampling is not as much on the size of the sample, as it is on the quality of information obtained (Padgett, 1994; Sandelowski, 1995). The sample population should allow sufficient in-depth interviews to gather a sufficient understanding of the participants' experiences (Creswell, 2007) given that the intent is to collect extensive details about each site or individual studied, to explain the phenomenon and draw specific conclusions. In this investigation we planned to conduct approximately ten interviews, which were considered enough to achieve good coverage with regard to financial euroization. However, one bank did not respond positively and two planned interviews could not be held due to civil disturbance in Macedonia on the days of the scheduled interviews. With data collected from only seven interviews, we reflected carefully and believe the number is sufficient to gain an understanding of the risks of financial euroization in banks in SEE countries.

5.5 Data collection procedure

This section details the overall interview design, the interview procedure and the secondary data employed in the analysis.

5.5.1 Interview design

The qualitative research consisted of face-to-face in-depth interviews with the representatives of the targeted banks. For this investigation, the interviews were conducted in a semi-structured format, the most widely used interviewing format in qualitative research literature. Semi-structured in-depth interviews are generally organised around a set of predetermined open-ended questions, which allow the interviewees to build on and explain their responses, which can give the researcher more detailed and richer data (Flick 2002; Saunders et al, 2003; Bryman, 2006).

The main advantage of using semi-structured face-to-face in-depth interviews is that they provide much more detailed information than fully structured interviews. The depth of information is very important for this investigation, considering that the focus is in gaining insight, exploring and understanding the perspective of participants regarding the phenomenon of financial euroization (Gillham, 2000; Ritchie and Lewis, 2003). The face-to-face interviews also overcome the issue of poor response rate of a questionnaire survey; face-to-face contact with a researcher can motivate respondents to participate who would otherwise not bother with a questionnaire (Gordon, 1975). The dimension of the partial structure allows for replication of the interviews enabling a certain degree of standardization, which increases data comparability and reliability. Validity is facilitated also through the opportunity of observing other non-verbal indicators, which is particularly useful when discussing sensitive issues (Gordon, 1975).

The interviews had a structured order of different topics related to the key research sub-questions about banks' perspectives and attitudes towards financial euroization and the elements that they believed underpin FE. Sub-questions were grouped thematically around main themes and were used for reference; additional prompts were used to draw out respondents' opinions if necessary. The interview questions are presented in Appendix 5.3.

5.5.2 Interview procedures

The interview timeline:

- The researcher approached potential participants through intermediaries.
- The participants were provided a priori with the informed consent form, a statement letter, and the questions of the interview.
- The interviews were set up at participants' natural settings, at the date and time of the participants' choice.
- At the beginning of the interview the researcher introduced the research project, the consent form and answered the participants' questions.
- The interviews began after the participants signed and dated the consent form, which was retained by the researcher.

The interviews were guided by a set of topics/questions. The potential participants were approached through intermediaries, to reassure them of the academic nature of the research and the author's commitment to confidentiality of the interviews. In order to put them at ease and ensure a comfortable atmosphere, the location and setting for the interviews were set in line with the participants' requests (Bogdan and Biklen, 1992; Hatch, 2002). Each participant, with the exception of one, chose their natural work setting as the area where they felt most comfortable speaking. One decided that a neutral setting of their choice other than the work setting would be preferable for them. The participants were provided a priori with the written informed consent form, a statement letter written in plain language and the questions of the interview, so they could have an opportunity to look through the material in advance and be prepared for the upcoming interview, or withdraw from the undertaking altogether, if they so wished. At the beginning of each interview the author introduced the research project and elaborated further on the scope and objectives of the research, plans for using the results of the interviews, and answered the participants' questions To maximise open discussion, informed consent was discussed in detail, with an emphasis on confidentiality and the potential consequences of participation. The interview was guided by a set of topics/questions, and a list of prompts to draw out respondents' opinions. The author made sure to ask the same questions in all interviews. The new issues that arose in the first interview

the author continued to raise in each following interview to ensure comparability of the answers.

The interviews were conducted between June 16th, 2014 and July 24th, 2014, throughout Albania and Macedonia. Half of the interviews were conducted in English and half in Albanian language. Most of the participants in Albania, with the exception of one, preferred the Albanian language given that it was their native language and they felt more comfortable expressing themselves in it. Quotes in the discussion were translated into English by the author. The remaining respondent in Albania was a foreign person (for the sake of confidentiality, her/his national background cannot be revealed) and thus preferred the interview be conducted in English. The participants in Macedonia preferred the interview to be conducted in the English language. All interviews, with the exception of one, were audio-recorded so that the author could go back to the tape again for clarification if necessary, and the author could concentrate on the participants' answers rather than note taking. The author immediately transcribed the interviews verbatim. In the case of the interview which was not recorded extensive notes were taken during the interview.

The questions were grouped thematically based on different topics related to the key research questions. A list of prompts was used to draw out the interviewees' opinions. The partial structure of the interviews enabled the author to ask the same questions to all interviewees. Particular impressions regarding the interviewee and any observations, limitations to the data that were created by some aspect of the interview process, were recorded in field notes, which were used as an additional input to the data analysis process. Field notes were written after each interview, following the proposed template of Miles and Huberman (1994). A template of the field note used is presented in Appendix 5.4. It is worth mentioning that most of the interviewees were perceived by the author as dedicated employees, committed to their jobs and professionals. All but one participant were well informed regarding their bank's general strategy, policies and procedures and rationale behind them; they also responded candidly and seemed to use the questions as prompts to share their thoughts. One participant, who in general kept answers rather short, gave the impression that he was not very well informed about his bank's policies and procedures, although it was expected he would be given his position at the bank, i.e. he did not give the impression of being very professional. Another participant kept a

part of the answers rather superficial and at times attempted to give what appeared to be politically correct answers or what he thought was expected of him. That particular interviewee, although perceived by the researcher to be professional and well informed regarding the general strategy of the bank, was a senior manager and was not informed in detail regarding specific procedures. Due to the high seniority position, he might have been more inclined to give politically correct answers. As a priori expected, the one non-management risk officer that was part of the sample appeared as very professional and well informed regarding specific policies and procedures but not very well informed regarding the general strategies of the bank, most likely due to the limited scope of his duties and responsibilities.

5.5.3 Secondary data

Secondary data in this analysis are used as an additional input to the data analysis process. They provide additional information to strengthen the arguments and are used for the purpose of validity, i.e. to triangulate the findings of the study, an issue addressed in the following section. Besides field notes of the interviews, for the purpose of this analysis different legal documents and official statistics are used as secondary data. Legal documents consist of laws and regulations relevant to banking system in the countries in which the interviews are conducted, and important publications made by the regulatory authorities. They were collected from the official web sites of the relevant institutions. They provide information on how the banking system is regulated and supervised in these countries and on the regulatory authorities' policy goals with regard to FE. In addition to these legal documents, the banks' annual reports were collected because they were considered useful for a better understanding of their activities and current situation. The second category of secondary data used in the analysis process is quantitative data on FC. These data were collected from different sources (see section 4.4 for a more in depth discussion). They were initially collected for investigating quantitatively the impact of FE on bank efficiency but were used for validity purposes in this research as well.

5.6 Data analysis process

The collected data were analysed employing thematic analysis. Traditional thematic content analysis involves examining interview transcripts and finding common as

well as uncommon themes, which forms the basis of a draft coding framework (Silverman, 2011, Creswell, 2012). However, given the aim of this qualitative research is to build up on the previously conducted research, the set of the main themes were identified *a priori* based on the literature review and findings of the previously conducted research presented in Chapter 2, 3 and 4.

The analysis predominantly used deductive reasoning, where the themes were identified from previously conducted research. Yet, once the data analysis process commenced it was clear that these themes were unable to entirely explain the FE phenomenon and an inductive element was employed. The first stage of the analysis is examining the transcribed versions of the interviews to apply the previously set coding framework. In the second stage, the data are analysed based on the coding framework to explore patterns, causal conditions, and specific strategies regarding the central phenomenon. Once the analysis commenced in the first stage additional themes started to emerge and in few cases, the hierarchy of previously identified themes became more complex, these are further elaborated in the next section. The full list of themes and sub-themes is presented in Appendix 5.5. In addition to the interviews and participant observations noted in field notes, the data analysis process was also based on the review of the previously collected secondary data: legal documents and quantitative data. The study includes the most representative quotes considering their significance in "revealing how meanings are expressed in the respondents' own words, rather than the worlds of the researcher" (Baxter and Eyles, 1997, p. 508). For the data analysis process, no computer package was used, given the small size of the sample.

The analysis of data began with a list of themes and sub-themes linked to the literature and a priori considerations. In considering the first research question (see section 5.1.2) the following themes and sub-themes were developed from the literature:

a) FC Strategy
    i. Where established and why?
    ii. Factors influencing the FC strategy

In considering the second research question (see section 5.1.2) the following themes and sub-themes were developed from the literature:

b) Instruments employed to address the FC risks

i. Limits
ii. Credit standards and procedures

In considering the third research question (see section 5.1.2) the following themes and sub-themes were developed from the literature:

c) Drivers of FC lending:
   i. Hedging
   ii. Higher returns
   iii. Demand

Throughout the analysis, it was clear that the interviewees' discussion brought up in detail additional themes, which are addressed as emerging themes and are presented below.

d) FC indexed lending
e) Performance of FC loans
f) Encouragement of DC lending

5.7 Validity and reliability

The issue of validity and trustworthiness, which in essence is the internal evaluation of the quality of the study, is important to increase the credibility of the data and the findings (Kvale, 1996; Maxwell, 1996; Creswell, 2007). Validation is carried out through different strategies, but reflexivity, triangulation, and respondent checks are the most commonly ones employed in qualitative literature (Creswell, 2007). Reflexivity involves acknowledging the researcher's subjectivities, and possible biases toward the study (Parker, 1994; Sword, 1999; Finlay, 2002). In this investigation, the author at all times tried to be unbiased, however, the reader should note that the researcher author is an employee of a central bank (but not in Albania or Macedonia) and this may unintentionally influence how she sees things.

Triangulation is the most rigorous strategy for ensuring validation. It involves using multiple methods, multiple sources of data, multiple measures, and multiple viewpoints to shed light on the topic of focus (Lincoln and Guba, 1985; Merriam, 1988; Denzin, 1989; Miles and Huberman, 1994). This study triangulated the data from interviews, field notes and secondary data. The triangulation of data sources, in

essence refers to the triangulation of findings of qualitative data with the previously collected quantitative data. In addition, the study triangulated data between the interviews. Any theme identified from the interviews was considered in terms of the interviewees who addressed it.

The strategy of respondents checking their answers allows the researcher to obtain feedback from the participants of the study regarding any misinterpretations made by the researcher in summarising the data and drawing conclusions from the data (Merriam, 1998). However, risk managers are a challenging population to reach for academic research purposes, both because they tend to be busy people and because of the sensitive nature of their job. Although, the apparent openness with which they shared their perspectives is one of the strengths of this study, the inability to validate the data through respondent checks is one of the main limitations. However, it should be noted that we observed substantial internal consistency in views and themes across interviewees and with data findings of earlier quantitative research chapters. Finally, taking into consideration that the investigation is limited to the experiences of particular banks the generalizability of our findings is unknown. Nevertheless, the combined implications of their experiences should shed light on how banks view and address the FE phenomenon in SEE, therefore thematic generalizability (Creswell, 2007) is certainly a possibility.

5.8 The financial setting in Albania and Macedonia

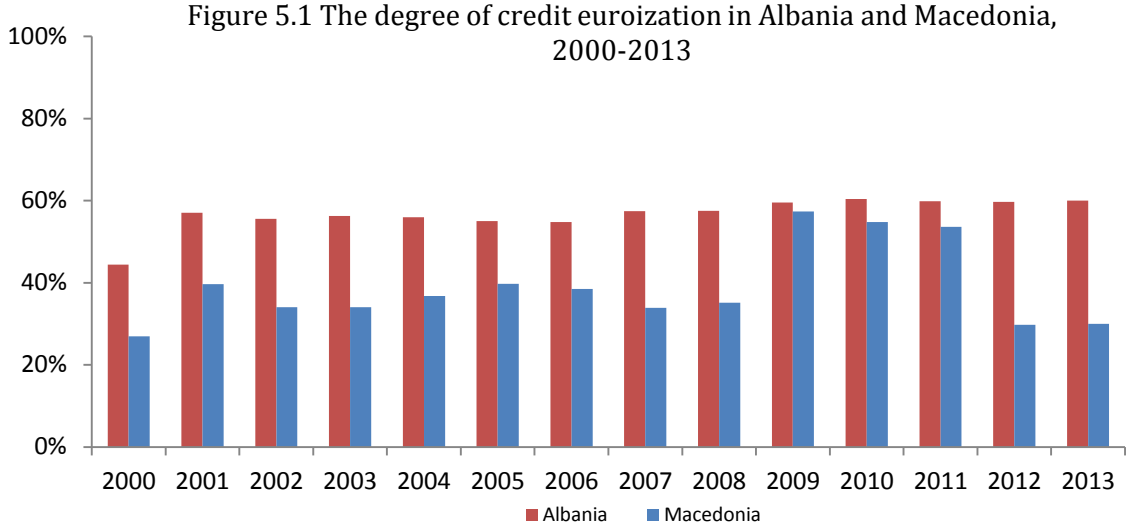
In this section, we elaborate on the background of the two countries in which the interviews were conducted. A comparative analysis of the two countries is considered necessary because the responses may vary given their particular attributes, therefore we should consider this in the data analysis process.

5.8.1 Financial Euroization

The significant degree of FE is another important characteristic of both countries, which will enable the desired exploration of the FE phenomenon. Whilst Albania has experienced a broadly stable high level of FE throughout the last decade, Macedonia has been characterized with a lower but stable degree of FE until the global financial crisis when it increased, reaching an all-time high of almost 60 percent. In the

following three years, there was a gradual decline of FE, followed by a sharp decline in 2012 to 30 percent (Figure 5.1).

Figure 5.1 The degree of credit euroization in Albania and Macedonia, 2000-2013



Source: respective central banks

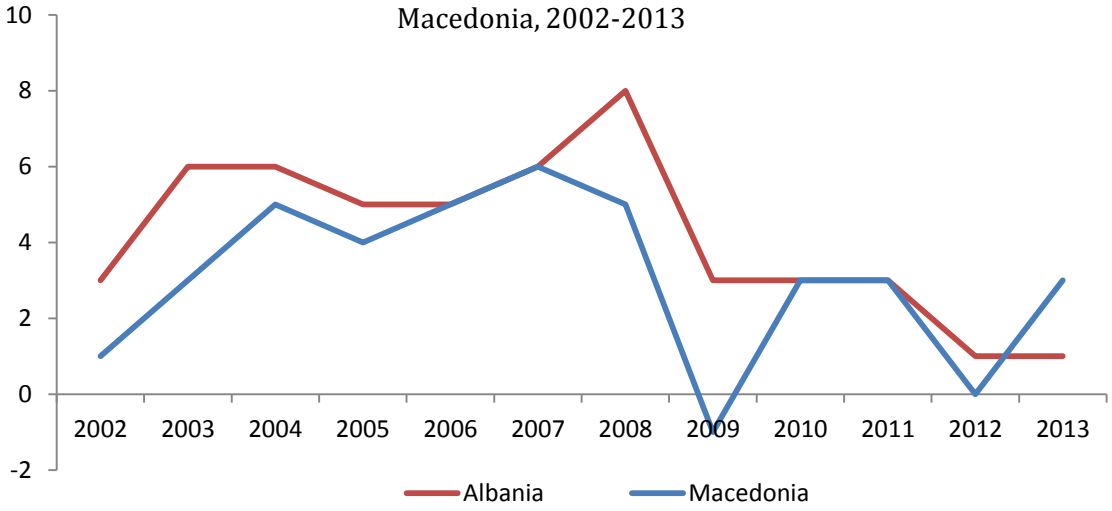
The different trends in FE make these countries interesting in exploring the implications of FE. Prior to year 2012, the central bank policies in both countries can be considered to some degree indifferent with regard to FC lending trends. Since 2012, both central banks have undertaken concrete steps to encourage banks to move towards DC lending activities which, according to our interviews, have proven successful. This was more highlighted in Macedonia, where the government regarded the sharp increase of FE during 2009 as a negative change and the Central Bank explicitly stated its strategy to encourage de-euroization of the banking sector through measures presented later in this section under monetary policy.

5.8.2 Economic development

The countries have followed different paths with regard to economic performance. Before the global financial crisis, between 2002 and 2008, Albania was considered one of the fastest-growing economies in Europe, with average annual real growth rates of 6%, whereas Macedonia experienced an average economic growth of 3.5 percent and was underperforming in comparison to the region. The economies also differ with respect to how they weathered the crisis: whilst the Macedonian economy contracted by 1 percent during 2009, the Albanian economy was one of the very few economies in Europe that continued to experience positive growth, although at half

its previous level. The growth of both economies deteriorated further in 2012 and 2013, reflecting the difficult situation in the Eurozone, but the Macedonian economy rapidly recovered in the following year whereas the Albanian economy stagnated.

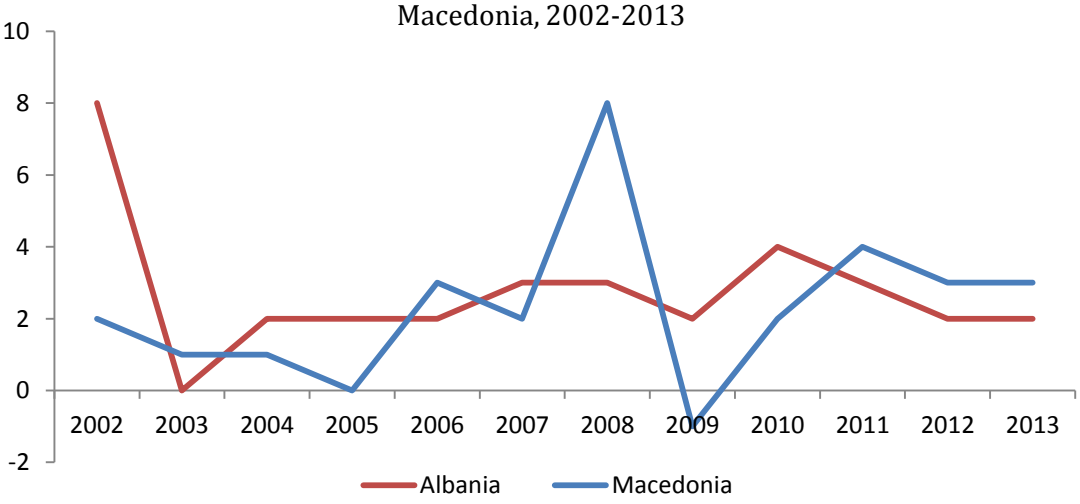
Figure 5.2 Average annual GDP growth (in percent) in Albania and Macedonia, 2002-2013



Source: World Bank, World Development Indicator 2015

The experience of the two countries also differs with regard to inflation. In Albania, the inflation rate in the past ten years remained low, close to two percent. In Macedonia, although the inflation rate was largely stable between 2002 and 2007, in 2008 it reached a high of eight percent but then in the following year dropped to a low of minus one percent (Figure 6.3.). Since then the rate has risen to over two percent.

Figure 5.3 Average annual Inflation rate (in percent) in Albania and Macedonia, 2002-2013

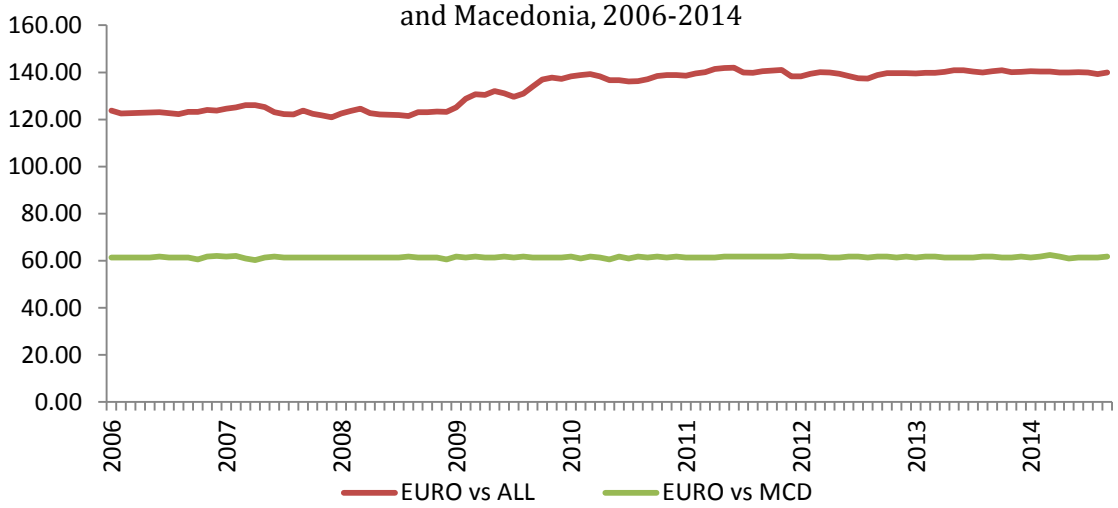


Source: World Bank, World Development Indicator 2015

5.8.3 Exchange rate regime

Another important attribute of the two countries is their exchange rate regime. Albania has a flexible exchange rate regime, although the Bank of Albania occasionally intervenes in the foreign exchange market with the aim of smoothing temporary fluctuations and accumulating the necessary reserves. Macedonia has had a fixed exchange rate regime (with very small margins) since 1995, originally against the Deutche-Mark and then against the Euro. As seen in Figure 5.4, the exchange rate in Macedonia has been relatively stable throughout the years. However, in Albania the exchange rate adjusted during the global financial crisis. Therefore, the perceived risks regarding FC may differ in two countries.

Figure 5.4 Exchange rates of euro versus domestic currencies of Albania and Macedonia, 2006-2014



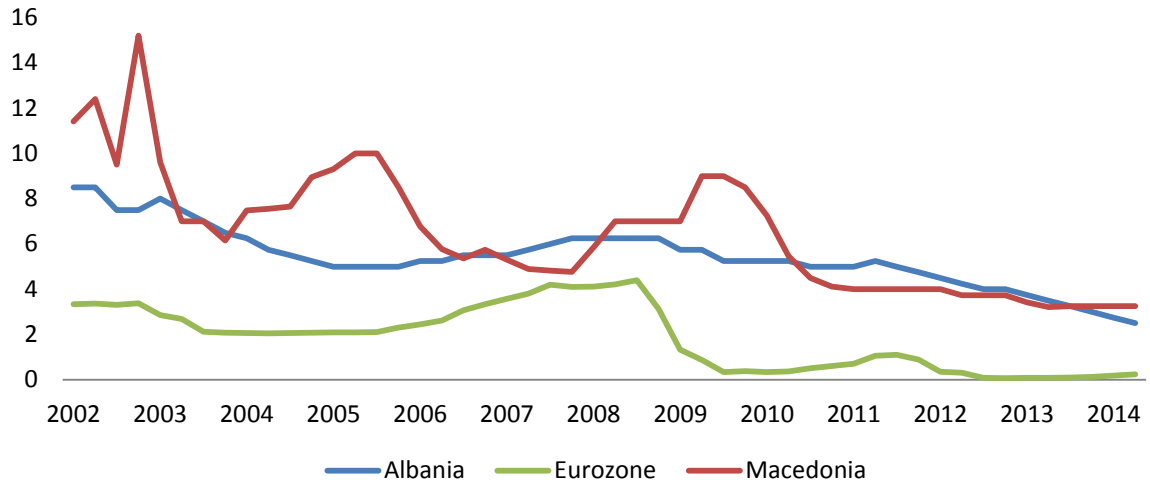
**ALL is the Albanian Lek; MCD is the Macedonian Denar*
Source: respective central banks

5.8.4 Monetary and Macroprudential Policy

The primary monetary policy tool in both countries is the interest rate on central bank bills. Both countries in the last few years have loosened their monetary policy with interest rates reaching historically low figures in the last year. Both countries have followed the Eurozone trend, although not at the same pace, in reducing the base rate after the global financial crisis, year 2009. In comparison to the reduction of the EURIBOR interest rate, Albania reduced the interest rate very gradually until 2012 after which the reduction was greater, reaching the historical low of 2.5 percent. On the other hand, Macedonia followed more closely the Eurozone, with a sharp reduction in the base rate during 2010 and a gradual decrease during the following years, reaching a historical low for Macedonia of 3.5 percent (Figure 5.5). However,

taking into the consideration the EURIBOR rate has also been at an historical low, the gap with the European base rate remains large.

Figure 5.5 Changes in interest rates in Albania and Macedonia, 2002- 2014



Source: European Central Bank, respective central banks

Besides monetary policy, governments in both countries have applied macroprudential policy instruments directly linked to currency throughout the period under consideration. These policies include reserve requirements on domestic and foreign currency liabilities, credit growth ceilings, and liquidity ratios. The main aim of macroprudential policy has been to contain or reduce the level of euroization. Both countries during 2012 changed the reserve requirements on domestic and foreign currency liabilities. Albania stopped offering remunerations for required reserves in FC. In addition, they increased the required capital holding for the risky assets in FC. Macedonia reduced the reserve requirements for DC liabilities and simultaneously increased requirements for the FC liabilities.

5.8.5 Banking Sector

Albania and Macedonia in the last decade have been characterized by financial deepening. Domestic credit has risen substantially relative to GDP, suggesting that banks have become more important in both countries; however, it remains relatively low, less than 50 percent of GDP. In the years prior to the global financial crisis, both countries were experiencing financial deepening at a faster rate, but this has slowed. It is worth noting that financial deepening in Albania was faster than in Macedonia before the crisis, but also it slowed more after 2009.

Table 5.3 Banking sector indicators in Albania and Macedonia

	2005	2006	2007	2008	2009	2010	2011	2012	2013
ALBANIA									
Domestic credit to private sector (% of GDP)	15%	22%	30%	35%	37%	38%	39%	39%	38%
Number of banks	17	17	16	16	16	16	16	16	16
Foreign ownership	92%	91%	94%	94%	93%	91%	90%	92%	92%
MACEDONIA									
Domestic credit to private sector (% of GDP)	24%	29%	35%	42%	44%	44%	45%	48%	49%
Number of banks	20	19	18	18	18	18	17	16	16
Foreign ownership (share of FO in total assets)	51%	53%	86%	93%	93%	93%	92%	92%	68%

Source: EBRD, central banks, World Bank

The banking sectors of both countries are mainly foreign owned. The share of foreign ownership in the Albanian banking sector has been large and stable, above 90 percent, throughout the period from 2005 (Table 5.3). In the Macedonia, the share of foreign ownership increased from just above 50 percent in 2005 to 92 percent in 2012, but then reduced to 68 percent by 2013. The sharp drop experienced in the last year reflects the fact that one bank was transferred from foreign ownership to domestic ownership. In both countries, the capital is mostly European, with Greek and Slovenian capital dominating the Macedonian banking sector, and Greek and Italian dominating the Albanian banking sector. In 2013 there were 16 banks operating in each country. Since 2005 the number of banks decreased by one in Albania, but the decrease was larger in Macedonia where the number of banks fell from 20 to 16 (Table 5.3). The banking sector in both countries has weathered the global financial crisis relatively well and remained largely stable during the Eurozone crisis. Nevertheless, the banking sector still faces considerable risks from the deleveraging pressures from foreign parent banks, prolonged weak growth, and the continued deterioration of banks' loan quality, particularly in Albania where the NPL ratio at end November 2013 reached 24.2 percent of total loans with negative consequences for credit growth. Therefore, further deleveraging pressures, which may result from the European Central Bank's Comprehensive Assessment of the asset

quality of leading Eurozone banks, set to take place in the first half of 2015 could influence capital constraints in their subsidiaries operating in Albania and Macedonia.

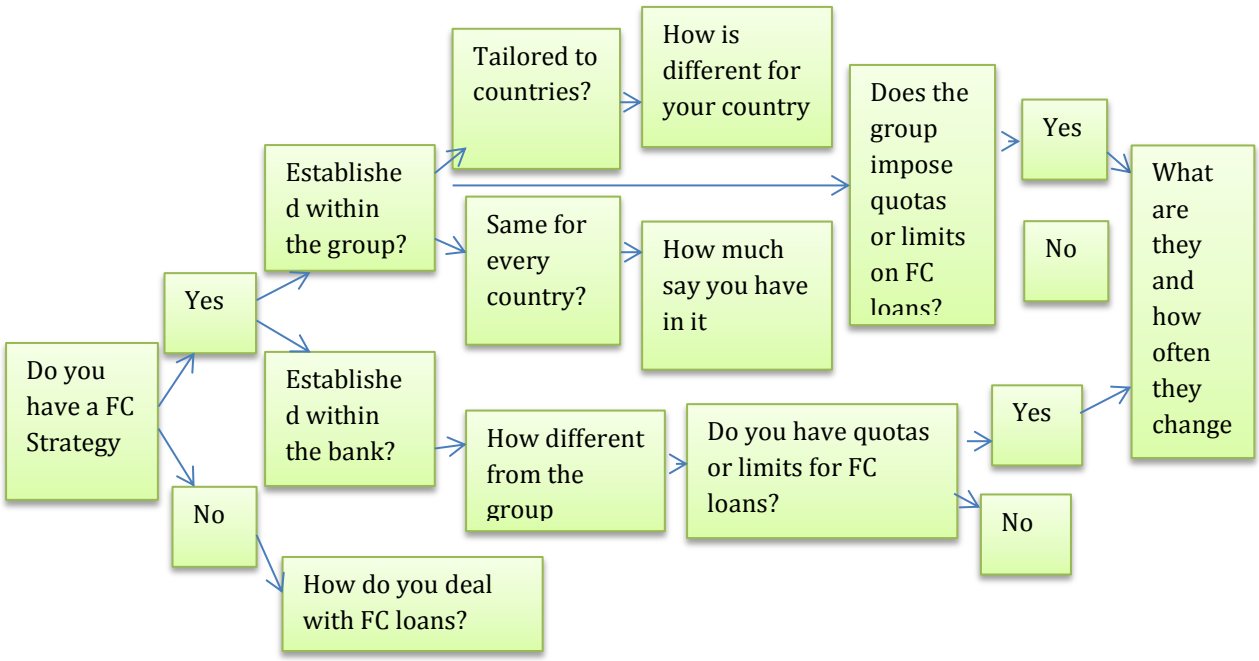
5.9 The main findings

This section presents the main findings of this investigation, which are structured around the main themes of the research. We would have liked to have produced a cross table of details with more information on individual banks, but to do so would enable the identification of banks and compromised the interviewees. In addition, to avoid thisbank characteristics have not been linked to respondent's replies.

5.9.1 Foreign currency loan and deposit strategy

Understanding banks' strategies with regard to FC loans and deposits was the key research topic related to the first research sub-question. The questioning related to the theme of FC strategy is presented below and branching is presented in Figure 5.6. The researcher started with a general question whether the bank had a specific FC strategy. If they did, then they would be asked to elaborate on it, with the researcher using prompts to develop the depth of the information.

Figure 5.6 Branching of the answers regarding the FC strategy



Four out of seven interviewees responded that their bank does have a specific FC strategy. Two of these four stated that their FC strategy is established within the

group, but that it is tailored to specific countries. One of these two had a very general strategy according to which at all times "the FC loans should be lower than FC deposits; FC loans should be funded completely from the FC deposits within the bank" (interviewee No. 3). This interviewee argued that the group decided that each country's bank ought to fund completely the loans in FC with the deposits in FC raised in that country. The strategy of the second bank was much more specific. According to the respondent, the aim of the strategy was to decrease the exposure to FC lending in every country where the group was present. However, the desired degree of exposure was different for each country. The strategy had annual and even monthly set targets for each bank to meet, thus the FC issue was addressed in a very central manner. In addition, the restriction on the FC exposure was even more highlighted in this bank's strategy, under which, since 2012, the bank had stopped issuing loans indexed to FC as a product. The interviewees from the two banks that had a specific FC strategy which was established within the bank highlighted that their FC strategy was in compliance with their groups' general strategy.

Three out of seven interviewees responded that their bank does not have a specific FC strategy. However, they highlighted that they treat FC lending through different rules and procedures, which are set within their general lending policies. Two of them pointed out that they are relatively independent from the group in setting and in applying these rules and procedures. The third one maintained that their FC rules and procedures are very much in line with their group's requirements.

With regard to factors influencing the need and type of FC strategy, it was observed that banks that were independent in establishing their strategies were usually characterized by a different business focus in comparison to the group overall. In such cases, the group would decide that given the small share of the individual bank, which is the usual case for most of the banks in the region, the exposure to FC risks by the group was limited, thus they could afford leaving the FC risk management up to the individual bank. The experience with FC risk also seems to influence the need and type of FC strategy. It was observed that banks whose group had previous experience of problems with FC risk in any of the countries in which they are present in are usually characterized by more specific FC strategies, with the group having tighter control over the type of FC strategy employed by the individual banks. In addition, it was clearly pointed out by most of the interviewees that the government policies of

the countries in which they operate has a significant impact on banks' FC strategies, for a further elaboration see section 5.8.6.

5.9.2 Instruments employed to address the FC risks

In relation to the second research sub-question, the literature and a priori considerations suggests that limits, and credit standards and procedures are the main instruments employed by banks to address the FC lending. The currency mismatch theme emerged from the data in relation to the risks related to FC, according to the banks. The questioning related to the theme of limits is presented below.

Limits

The interviewees were explicitly asked whether they have any limits or quotas with regard to FC loans. Four out of the seven interviewees responded that they do not have written limits (Table 5.4). However, one of these four pointed out that they have a certain position regarding limits such as "keeping FC loans lower than deposits" (Interviewee 3). The other three interviewees responded they have explicit written limits for FC loans. Two of them stated that the FC limits were set within the group level. One of these stated that they "have limits on a total base and for specific portfolios, which change every year and have to report on to the group every month" (Interviewee 4). The other highlighted they have "limits on new loan volumes and on the entire loan volume as well" (Interviewee 6.) which also are revised annually and they have to report to the group on monthly basis. Only one bank maintained that their FC limits were set within the bank and not within the group. In addition, it is important to note that the interviewees of banks that had FC limits pointed out that the loans extended to naturally hedged clients are not counted within FC limits.

Table 5.4 The number of banks that had FC limits

	Banks with written FC limits	Banks with FC limits set within the group	Banks with FC limits set within the bank
FC limits	3	2	1

Source: own calculations

Regarding regulatory limits, in Albania following the Financial Sector Assessment Program's (FSAP)[9] recommendations, the Central Bank established limits regarding FC lending by prohibiting banks from having an FC exposure in aggregate exceeding 400 percent of its regulatory capital. Exposures exceeding the limit are deducted from regulatory capital. Moreover, the risk weight for these exposures is set at 150 percent. During 2012, Macedonia introduced limits prohibiting banks from exceeding an aggregate foreign currency position of more than 30 percent of their funds.

Credit standards and procedures

The theme of credit standards and procedures overlaps with the theme that emerged of currency mismatch risk. Therefore, this section will explain whether the banks employ different credit standards and procedures in relation to FC loans, and if so what tends to influence the difference.

Four interviewees responded that their bank's credit standards and procedures are tailored to clients' sensitivity with regard to FC risks. They seem to employ stricter credit standards and procedures for clients assessed as highly sensitive to FC risks. Three banks maintained their credit standards and procedures do not vary with FC risk. In assessing their clients they decide to extend the loans or not but do not differentiate the criteria by currency.

Currency mismatch

Interviewees were also asked to elaborate on the FC risks they face and how they manage them. During the analysis of the interview material the sub theme of currency mismatch emerged. When discussing FC risk every interviewee mentioned currency mismatch, which is lending in FC to firms and households who receive their income in DC, as the main risk they face is related to FC lending. For a detailed discussion regarding currency mismatch please refer back to sections 1.3 and 2.4. Four out of seven respondents responded they have stricter lending policies in the presence of currency mismatch risk (Table 5.5). One of them stated that in this situation "debt to income ratio (DTI) and collateral coverage requirements are always higher"

[9]The FSAP program is a joint IMF and World Bank effort, introduced in May 1999, designed to carry out an in-depth assessment of a country's financial sector and produce recommendations of a micro- and macro-prudential nature, tailored to country-specific circumstances.

(interviewee 1). Another respondent pointed out that although they "operate under the principal rule of always aiming for currency matching; they do have mismatches in their loan portfolio" (interviewee 4). The remaining three respondents highlighted they have very standard credit policies and procedures independently of the presence of currency mismatch. All respondents maintained that they take into account natural hedging, i.e. if the client is a net exporter

Table 5.5 The number of interviewees citing the issue of currency mismatch

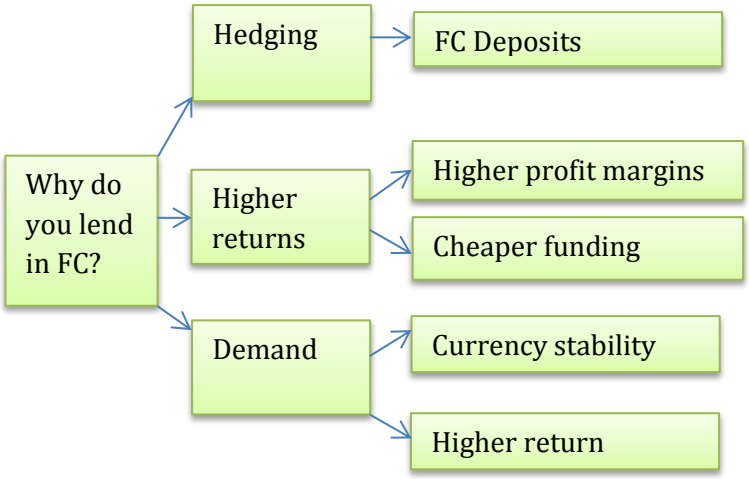
	Interviewees who cited this issue	Interviewees who cited more restrictive policies in presence of CM
Currency mismatch (CM)	7	4

Source: own calculations

5.9.3 Drivers of FC lending

One of the three building blocks of the empirical research of this thesis is euroization. Given the opportunity, we wanted to explore qualitatively the reasons behind FE through banks' perspectives. The researcher addressed the topic initially through an open question of why they lend in FC. Later on, the interviewees were asked to rank the reasons according to their importance.

Figure 5.7 Branching of the answers regarding the drivers of FC lending



All respondent ended up listing the same three reasons although not always in the same order. Demand is identified as the main reason behind the FC lending, with five respondents listing this as the first reason, one respondent as the second reason and

one respondent as the third reason (see Table 5.6). The simplicity of banking in these countries seems to be the rationale behind this, as one respondent points out that "in a market where all that banks can offer are loans and deposits- a simple market, we totally depend on market demand" (interviewee 1). According to all respondents currency stability, or the perception of the foreign currency as the more stable currency, is what drives the high demand for FC loans. The respondents in Macedonia acknowledge that this is interesting given that in Macedonia the exchange rate had been very stable for a very long time. Another respondent argues "the high demand for FC is induced, because of the high base rates" (interviewee 3). One respondent also suggests "people demand FC loans because they think they will have the euro in future so are already focused on moving towards euro" (interviewee 2). Nevertheless, it must be noted that all banks pointed out that besides currency stability, lower interest rates on FC loans in comparison to the DC loans were a strong reason behind the demand for FC loans. This suggests that FC lending is not actually entirely demand driven.

The second most quoted reason behind the high level of FC loans is hedging: one interviewee gave it as the first reason, four as the second reason and two as the third reason (see Table 5.6). Banks, according to interviewee 4, "have large deposit base and are over liquid in euro" thus need to hedge and protect themselves with regard to FC positions by having assets in FC. In SEE countries where the banking market is simple, lending in FC is virtually the only hedging instrument for these banks because there are no other well-established financial hedging instruments at reasonable cost (see section 1.4). All banks maintained that the reason given by the respondents behind the large deposits base in euro is the currency stability. Banks have been consistently offering higher interest rates on the domestic currencies to increase their deposits base in domestic currency.

Table 5.6 Drivers of foreign currency lending according to the banks

	Cited this reason	**Cited this as the 1st reason**	**Cited this as the 2st reason**	**Cited this as the 3st reason**
Hedging	7	1	4	2
Demand	7	5	1	1
Higher returns	6	1	2	3

Source: own calculations

Higher returns or higher profitability is the overall third reason behind FC loans according to the interviewees. One respondent lists it as the first reason, two respondents list it as the second reason and three list it as the third reason for the high level of loans in FC (see Table 5.6). These respondents consider profitability as an important reason for FC lending given the higher profit margins on FC loans and cheaper FC funding. They are in positions where they can obtain FC funds at lower cost compared to DC funds, whether it is in the form of a credit line with very favourable conditions from the parent bank or the group, or domestic deposits at lower interest rates. This enables the bank to obtain a larger profit margin than with loans in DC or invested elsewhere with lower interest rates. All interviewees stated that the high base rates in the country in comparison to historically low rates of EURIBOR and LIBOR limits their profit margins in DC assets. However, one particular interviewee did not list higher returns as a reason for loans in FC. He argued that as a bank they fund all their FC loans completely through their own FC deposits and thus they consider their profit margins very similar to DC loans. It is worth mentioning that according to one respondent higher returns might be a very valid reason for products such as mortgages, and any type of business loans, however one must bear in mind that the products in which banks usually charge the highest interest rates such credit cards, overdrafts, and credit lines, are only offered in domestic currency thus making the assets in DC relatively more profitable. However, it is not possible for the researcher to get the data for FC loans categorized by product type, which would enable a more reliable comparison of the profitability of FC loans in comparison to DC loans whilst controlling for product type.

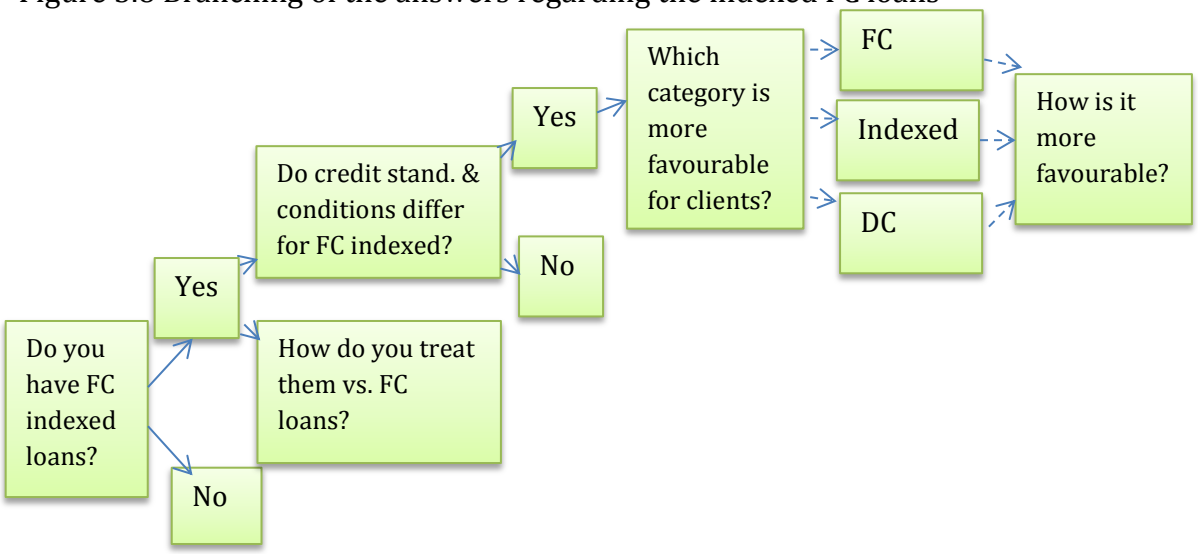
5.9.4 Foreign currency indexed lending

FC indexed lending is one of the themes that emerged in this qualitative study. In the previous theoretical and empirical chapters it was noted that in a few TEs, particularly in SEE, banks were also offering a third type of loans in addition to loans in FC and DC, referred to as FC indexed loans. In general, this type of lending would consist of disbursing the loans in domestic currency but linking or indexing it to foreign currency[10]. Although it would have been interesting to investigate the effect of

[10] The indexed loans are disbursed in DC, with a fixed normal exchange rate on a historical average, and the interest rates are more favourable than DC loans and less favourable than FC loans. However, the banks reserve the right to change the interest rates, if the ER fluctuates above the threshold.

these loans, banks do not report any data on them, so it was not possible to quantitatively investigate their implications. FC indexed loans were addressed first through a question on whether they had any FC indexed, or linked, loans. The branching of the answers is provided below in Figure 5.8. If the interviewee responded that they do, they were asked to further expand on the subject, the researcher using prompts to get the relevant information.

Figure 5.8 Branching of the answers regarding the indexed FC loans



Five interviewees responded that they do not offer loans indexed to FC. The other two responded that they do have loans indexed to FC, although they both noted that the indexed lending was always a small part of their loans portfolio (around 10 percent). One of the two respondents noted that indexed lending is less significant in comparison to pure FC lending because they offer indexed loans as a product only to private individuals/households. The other respondent pointed out that since 2013, they have stopped issuing new indexed loans as part of their new FC Strategy (see section 5.8.1), but their active loan portfolio still contains some indexed loans.

With regard to why they offered indexed lending, the interviewees pointed out that they started offering the indexed loans because the regulatory authority, i.e. the central bank, forbade lending in FC to individuals/households. Therefore, through indexed lending, banks were offering to clients another option of, in effect, borrowing in FC whilst being compliant with regulatory requirements. Both interviewees maintained that although with regard to risk they consider indexed loans identical to FC loans, they both treated them differently in terms of credit standards and

conditions to DC and FC loans. According to them interviewee indexed loans were less favourable than FC loans for the clients because they were charging interest rates similar to DC loans, but more profitable than DC loans because they were fixing the exchange rate to a historical average, and thus hedging against possible depreciations. Both interviewees maintained that the favourable category was identified in terms of favourable interest rates and lower required collateral coverage.

5.9.5 Quality of foreign currency loans

The exploration of the quality of FC loans, and FC indexed loans when present, was another area of interest in this analysis. Although, initially there was some doubt about whether the interviewees would be comfortable discussing the quality of FC loans, the researcher was surprised with how candidly they talked about the issue. The interviewees, were initially asked if there are any differences with regard to performance, and if yes to compare the loans categories with regard to performance. In addition, they were asked for the reasons for their responses to the first question.

All interviewees responded that there are no significant differences in performance between the categories. They all perform stress testing with currency based scenarios and different types of sensitive tests and do not find any particular differences with regard to currency. As one interviewee pointed out "in all stress testing no deterioration attributable to foreign currency loans has been identified" (Interviewee 1). Another interviewee argued that "the FC risk have not been a decisive element in influencing the non-performing; it is mainly other reasons, sectors, individuals or behavioural element" (Interviewee 4.). These arguments are very much expected in the case of Macedonia where the exchange rate has been stable for the last 15 years, but are somewhat surprising in the case of Albania with different government policy and the experience of exchange rate variations during the global financial crisis.

5.9.6 Encouraging lending in DC

A recurring discussion in all interviews was recent movement of the banks towards the DC currency. They pointed out that besides the restrictions on FC exposure they were decreasing the gap on interest rates offered on FC and DC deposits. All banks

maintained that the recent government policies, such as macroprudential policy were the reason behind this movement. All interviewees noted that in the last two years, or at least the last year, their regulatory authorities had been directly and indirectly encouraging DC lending (previously referred to in section 5.4). According to one interviewee the central bank "has stimulated lending in DC by reducing the base rate, and by increasing the reserve requirements for deposits in FC whilst decreasing it for the deposits in DC" (Interviewee 6). Another interviewee pointed out that their Central Bank is stimulating the DC lending "by reducing the base rate, and through the new regulatory requirement of requiring significantly more capital set aside for risk weighted assets in FC than those in DC" (Interviewee 3).

Table 5.7 The number of respondent citing issue of DC lending

	Cited this issue	**Cited reduction of base rate as an instrument**	**Cited higher reserve requirements on FC as an instrument**	**Cited new regulatory changes with regard to RWA* as an instrument**
Encouragement of DC lending	7	7	2	5

*Risk weighted assets (RWA) are assets classified in terms of their riskiness to determine a bank's exposure to potential losses and the capital needed to sustain those losses.
Source: own calculations

5.10 Discussion of the findings and implications

In this section, the connections between the main findings and the euroization literature are explored whilst taking into consideration bank and country contexts, which was not possible to fully carry out in the previous section without endangering the disclosure of the bank's identity. The discussion is structured around the key research questions underpinning this study.

> *What is your strategy with regard to financial euroization? What tends to determine or influence the need for and nature of FE strategy? Does it vary with bank characteristics?*

In relation to the first research sub-question in this chapter, the lack of earlier research made it difficult to construct a comprehensive framework to be used as a basis for comparison. Nevertheless, the analysis revealed that FC strategies pursued by banks, in general, seem to be sensible in terms of their objectives.

The typical strategy of the banks in the sample is hedging against the risks related to FC such as currency and currency mismatch risk. In one particular case the FC strategy is focused on hedging and reducing the level of FE exposure in terms of volumes simultaneously. Of those banks that had a specific strategy, the majority of the sample seem to have the FC strategy set at groups' headquarters, suggesting that hedging is being centrally managed. However, all strategies seem to consider naturally hedged customers such as net exporters as fully hedged and thus did not treat them as FC loans in terms of risk. This is interesting because whilst the risk of default for naturally hedged clients in terms of currency mismatch might very well be negligible, these loans are still extended in FC. Thus by excluding them from their FC limits, banks may not fully be matching the FC assets and FC liabilities in their balance sheets. With unmatched currency positions, with a change in the exchange rate banks are going to have an immediate effect of an exchange rate change on their books, which is not in line with a bank taking a fully hedged position. Thus, the seeming complacency towards naturally hedged customers is not in line with the bank taking a fully hedged position, and, what it is more, this seems to be in line with the current government policies. This is concerning because whilst, from the country's point of view, on the surface this may be sensible because there are limited cases within a country and thus the risk to the bank may be considered minimal, the risk to the bank overall may not be that small if all the countries have this policy. This implies that the countries might need some sort of regional agreement on limiting this source of risk to the banks.

Various factors were linked to the determination of the FE strategy. The parent group's focus seems to be an important determinant. It was observed that banks that were independent in establishing their strategies were usually characterized by a different business focus in comparison to the group overall. The study indicates that previous history with FE risk is another particularly important factor influencing the setting of the FE strategy. It seems that if the group has had previous experience with a negative outcome of FE risk in any of the countries in which it operates, the FE strategy is entirely managed at the group level i.e. centrally. This suggests that banks are not being completely proactive but rather reactive with respect to hedging. In addition, it was observed that the FE strategy is also constrained by the government policies in the county where the bank operates. Most of the banks in both countries pointed out that they are restricting their FC loans and deposits and are moving

towards DC currency, mostly due to the new government policies. This indicates that government policies in the countries where banks operate seem to be effective.

Regarding bank characteristics, the study suggests that FE strategy does not vary with bank size. However, it must be noted that perhaps the findings do not reflect the impact of bank characteristics given that, as suggested by the findings, the FE strategy of the banks in our sample is largely established at the group level, with the few exceptions mentioned above, and that the banks included in this research, despite varying between each other in size, are mostly small within their group.

> *What are the procedures and processes employed by the banks to address risks related to financial euroization? Do these vary between banks and over time?*

In relation to the second research sub-question the review of literature on euroization, presented in Chapter 2, we argued that currency mismatch risk is the main source of fragility for the financial system in the presence of euroization (Goldstein and Turner, 2004; De Nicolo et al., 2005). In the presence of financial euroization, banks attempt to hedge against foreign exchange risk in their balance sheets by matching their FC liabilities i.e. deposits with FC assets i.e. loans. Lending in FC is virtually the only hedging instrument for these banks because in SEE countries there are no other well-established financial hedging instruments at reasonable cost (see section 1.4). Nevertheless, by lending in FC they are not entirely hedged if their customers have not been matching their assets and liabilities in their balance sheets in terms of currency as well. In situations when the customers assets i.e. income are in DC whilst, their liabilities i.e. loans are in FC they are more vulnerable to the foreign exchange risk. Consequently, their ability to repay their obligations to the banks is affected, making banks more vulnerable to credit risk. The evidence presented above suggests that many banks consider the currency mismatch risk as the main risk related to FE. Therefore, the study supports the view that currency mismatch risk is of recognised by banks as important.

The study reveals that the typical procedures and processes employed by many banks in the sample seem to be in line with a FC strategy that is concerned with reducing the foreign currency risk. Banks in our sample, in general, seem to be concerned with hedging against the currency mismatch risk. In terms of instruments, procedures and

processes used to manage it, the study showed that banks employ limits, and different credit standards and procedures.

Limits related to FC loans are used with regard to total loan stock, new volumes, or specific sector, or with regard to FC deposits. They seem to be usually revised annually, but followed monthly. In terms of hedging strategy, this seems to be a sensible timescale in a relatively stable environment, but it would need to be adjusted quickly in less stable environment. Whether these banks have the right policies and procedures in place to respond quickly in times of turmoil remains to be seen. The study showed that most of the time the limits are set within the parent group, with the exception of the cases in which the bank is already independent in FE management from the group. It is worth noting that most of the banks maintain that loans extended to naturally hedged customers, such as net exporters, are not included in their FC limits. This may, of course, expose the banks themselves to foreign currency risk given that by excluding them from their limits they are not fully hedging their positions.

The study also revealed that over half of the banks in our sample seem to employ stricter credit standards and procedures in the presence of currency mismatch in the assets and liabilities of their clients. Some, but not all, either require higher collateral coverage or lower debt to income ratios, or both. However, few banks have standard credit procedures, in the sense that they do not apply stricter credit criteria in the presence of currency mismatch risk, they only decide to extend the loan or not.

Albeit, the study suggests that there is much of hedging going on with regard to currency mismatch risk, banks acknowledge that a certain degree of currency mismatch is present in their portfolios, particularly in their mortgage portfolio loans. The fact that the highest degree of currency mismatch is in their mortgage portfolios suggests that banks have maturity mismatches in their books as well. The combination of currency and maturity mismatches is worrying taking into consideration that the first one is considered responsible for triggering the 1997 Asian financial crisis (Chang and Velasco, 2003; Godlstein and Turner, 2004; De Nicolo, et al., 2005) and the second one is considered the major cause of the 2008 global financial crisis (Brunnermeier et al., 2009; Park, 2011). Nevertheless, this has not proved a problem up to this point in time in either country investigated. This is not surprising for Macedonia given the exchange rate stability linked to the fixed

exchange rate regime. However, in Albania, the exchange rate adjusted during the crisis period and the fact that problems of currency mismatch did not materialize is perhaps surprising. An explanation might be that Albania's economy weathered the global financial crisis quite well because its exchange rate adjusted, so maybe although there was an exchange rate effect, the economy being more positive in general, actually meant that there were not a lot of defaults on these debts. Alternatively, maybe the degree of currency mismatch risk is not large, as perhaps these clients are getting some flows in foreign currency in forms of informal remittances, and thus are at least partly FC hedged, although this is not taken account of by banks in their processes.

> *What are the drivers of foreign currency lending? Do they vary between banks and over time?*

In relation to the third sub-question, the euroization literature identifies the drivers FC lending as: interest rate differential between the DC and FC; bank currency matching i.e. matching of FC liabilities (deposits) with FC assets (loans); exchange rate volatility and exchange rate policy; and the openness of the economy in terms of easier access to foreign funds, (for a more in depth discussion, please see section 3.2).

The findings in this chapter confirm the existing literature. The interviewees clearly suggested that currency matching by banks is the most important driver behind FC lending. According to them, this is a long-term determinant thus contradicting Neanidis and Sava (2009), who argue that bank currency matching is an important driver for FC lending only in the short run. This thesis highlighted in section 1.4 that the underdeveloped banking systems and financial markets in TEs mean that banks operating in these countries can hedge their FC liabilities only by lending in FC. In the literature, the preference for foreign currency as store of value is rational in the presence of high inflation and exchange rate volatility. However, the literature argues that in the long run the domestic currency re-establishes itself (Ize and Levy Yeyati, 2003; Basso et al., 2011). This investigation partly supports these views given that banks maintained that it is the customers who seem to prefer depositing their money in FC initially, because they perceive it as more stable. However, the experience in these countries does suggest that presence of FC deposits continues for a long time after currency stability is established. The investigation suggests that for the DC to re-establish itself it may need active involvement of the government in setting the

correct policies. The recent government policies discriminating against FC lending, has encouraged banks to move towards DC lending. Banks have acknowledged that the differences in interest rates offered in FC and DC are much lower than before, mainly due to such government intervention. The research here suggested that banks are very much affected by the government regulations and the movement back to domestic currency seems to require the right policy setting.

The study also supports the literature in finding the interest rate differential between the DC and FC an important driver of FC lending. According to the interviewees, clients are comfortable with depositing their money in DC only with much higher interest rates than in FC because they perceive foreign currency to be more stable. Given the lower interest rate offered on deposits in FC, banks are able to offer FC loans with lower interest rates, making them more attractive to clients than DC loans.

The study suggests higher returns or higher profitability is the third identified driver of FC loans. Although the interviewees considered that due to cheaper funding FC loans have a positive impact on profitability, not all of them argued that this impact is large. The study showed that for products in which the profit margin for banks is larger, such as personal loans, credit cards and overdrafts, banks are required to offer these products only in domestic currency due to the regulatory framework. This then has implications with regard to the profitability of DC assets in comparison to FC assets. We are limited in further exploring or quantifying the profitability of FC assets in comparison to DC assets by product type, due to the lack of data on FC loans categorized by product types.

Finally, the analysis suggests that once euroization is present, a specific government initiative is needed to change euroization levels, an aspect not present in the existing literature presented in sections 2.3 and 2.5. The literature has not explained the persistence of euroization once the macroeconomic conditions in terms of inflation and exchange rate volatility have stabilized. This analysis has revealed that it is specific government policies such as macroprudential policies that aim the containment or reduction of euroization that can actually shift such persistence.

5.11 Conclusion

This chapter involved an investigation of the financial euroization phenomena from banks' perspectives, in SEE economies. The aim of the chapter was to investigate the financial euroization phenomenon in depth, through a qualitative investigation. In terms of design and methodology of the study ethical considerations constrained the investigation in the use of semi-structured face-to-face in-depth interviews without supplementing this with additional background data on each bank in order not compromise the confidentiality of the participants and banks. The semi-structured interviews were conducted by the author in the natural settings of individual banks operating in two SEE countries: Albania and Macedonia. The selection of Albania and Macedonia was based on the fact that they have their own currencies and are significantly euroized; however, they differ in terms of their financial systems, exchange rate regimes and economies in general. Consequently, it was expected that they might differ in terms of perceptions regarding financial euroization and related risks, and thus, the information obtained would enable a deeper understanding of financial euroization.

The findings of the analysis provide timely, informative, and enlightening insights into a topic that has influenced banks in TEs, particularly in SEE countries over the last two decades. Although the analysis was based in two selected SEE countries, the conclusions may have more general applicability in other TEs, at least in those with similar banking sectors and a considerable degree of financial euroization.

Initially the chapter, in line with the literature review in Chapters 2 demonstrates, that FE continues to be a significant characteristic of banks and banking sectors in these countries. Nevertheless, the main conclusion of this chapter is that government policies such as macroprudential policies regarding FE are affecting policies and procedures employed by banks. For a long time governments and central banks were indifferent towards FE and this seems to have allowed the high degree of FE in these countries to continue, given that banks' and customers' preference for FC in comparison to DC were not in conflict. However, this investigation indicates that macroprudential policies are becoming an important driver of de-euroization.

In addition, the analysis in this chapter revealed that banks seem to be concerned with hedging against the risks associated with FE. Furthermore, within our small

sample, hedging is being typically centrally managed, at the groups' headquarters, as it needs to be for hedging purposes. However, most of the banks in the sample seem to neglect the risks associated with one group of customers, exporters, and overly rely on the natural hedging available to this group. They all seem to exclude them from their foreign currency lending limits (section 5.8.2), which implies that banks are underestimating their own exposures in terms of the risks related to foreign currency. Moreover, there are indications that banks are not completely being proactive but rather reactive with respect to hedging. The banks with the strictest FC strategy seem to be those that had experienced losses with regard to FC risk in the past in their operations in another country.

In terms of the other drivers of euroization the findings of this analysis support the conventional view that deposit euroization and the interest rate differential were the main determinants of credit euroization in these countries.

Finally, in terms of the contribution to methods of investigation, the study showed that, future qualitative investigations in this research are could result in useful insights if they are carefully designed even though the confidential nature of the data makes this type of investigation difficult.

Chapter 6

The impact of macroprudential policy on financial euroization: evidence from TEs

6.1 Introduction

In the previous chapter, we looked at the financial euroization phenomena from banks' perspectives through a qualitative investigation. The findings provided evidence that government policies such as macroprudential policy are becoming an important driver of de-euroization. Macroprudential policy is mainly focused on reducing systemic risk, and is quickly gaining recognition as the appropriate policy in addressing financial stability. Therefore, as an extension to the qualitative analysis in Chapter 5 we decided to investigate the impact of macroprudential policy on financial euroization in the context of TEs.

As discussed in section 2.5.2 where the review of the theoretical framework on euroization was presented, there is a vast and diverse literature which comprehensively analyses the determinants of euroization, but the existing research is limited in its ability to explain financial euroization in TEs because of the following reasons. First, until very recently, most of the studies were focused on deposit euroization completely ignoring credit euroization, most likely due to lack of data. Second, the vast majority of the existing studies have definitional problems: they explain the determinants of payment euroization on the basis of currency substitution theoretical framework whilst using measures of financial euroization (Ize and Levy Yeyati, 2003). This is problematic because the use of measures of payment euroization and financial euroization interchangeably can be misleading since both determinants and conceptual implications of the two phenomena are different (Sahay and Veigh, 1995). Third, and to the best of our knowledge, the literature completely ignores the impact of macroprudential policy on financial euroization. Nevertheless, taking into consideration that a group of macroprudential policy instruments (MPIs) are directly related to credit and deposit euroization, it is to be expected that they may influence the level of financial euroization. The investigation in this chapter represents the first attempt at studying the potential impact of the macroprudential policy on financial euroization in TEs.

Emerging market economies are more experienced with macroprudential policy given that they have pursued it "more extensively than advanced economies, both before and after the recent financial crisis" (Lim et al., 2011; Galati and Moessner, 2014). They did so mostly due to their pronounced business cycles, their greater

exposure to volatile international capital flows and other risks, and the underdeveloped financial markets (Lim et al., 2011; Claessens et al., 2012). Macroprudential policy has been used actively in Central, Eastern and South Eastern Europe (CESEE), making this region a fertile ground for the investigation of their effectiveness (Vandenbusche et al., 2012).

In addition, the present investigation adds to previous research on the determinants of financial euroization by investigating the use of dynamic panel analysis to differentiate between the short-run and long-run effect of the determinants of euroization and to adjust for the potential endogeneity not only of the exchange rate volatility but also of the macroprudential policy variables. In the existing literature, only one study (Vieira et al., 2011) employs dynamic panel analysis to investigate the determinants of financial euroization. However, they focus on deposit euroization and cover the period before the global financial crisis using data up to 2006. The aim of this chapter is to provide policymakers in TEs information on the impact of the existing macroprudential policy on financial euroization, specifically credit euroization, so that they can make informed policy decision on the design and implementation of macroprudential policy.

The remainder of this chapter is organized as follows. The literature review on macro prudential policy is provided in section 6.2. Section 6.3 provides a critical discussion of the choice of measures for the model specification, which draws on the analysis undertaken in Chapter 2. The subsequent section elaborates on the data used for empirical estimations. The discussion regarding the empirical approach employed in this investigation is provided in section 6.5. The appropriateness of the model and the empirical results are discussed under section 6.6. The final section concludes.

6.2 Macroprudential policy: literature review

This section discusses the literature on macroprudential policy. It begins with a general discussion of the concept of macroprudential policy, its objective, scope, and instruments associated with it. It elaborates on the time and cross sectional dimensions of systemic risk. The empirical evidence on macroprudential policy is also discussed. The final sub-section concludes and formulates the hypothesis regarding the impact of macroprudential policy on financial euroization.

6.2.1 Macroprudential policy objective

Macroprudential policy, which is widely considered as a useful response to global financial crisis by many countries, is focused on reducing the systemic risk "by explicitly addressing the interlinkages between, and common exposures of, all financial institutions and the procyclicality of the financial system (Caruana, 2010). Systemic risk is difficult to define and quantify; however, the most widely used definition is the one prepared for the G20 Finance Ministers and Governors of central banks by the International Monetary Fund, the Bank for International Settlements and the Financial Stability Board. They define systemic risk "a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and has the potential to have serious negative consequences for the real economy" (IMF, BIS, FSB, 2009). As characterized by the International Monetary Fund and Bank for International Settlements, macroprudential policy targets the soundness of the financial system as a whole, rather than individual institutions, and applies instruments that are designed and calibrated to target systemic risk (IMF, 2011a; 2011b).

Given that it centres on systemic risk, the literature recognizes two main dimensions of macroprudential policy: the time dimension and cross sectional dimension, which were initially introduced by Borio and Crockett (2000). The time dimension or procyclicality addresses the cyclical systemic risk that occurs when during the upswings financial institutions take greater risks and expand their balance sheets, and the built-up hidden balance sheet mismatches increase the vulnerability of financial system and economy. The procyclicality paradox of credit, therefore, is that it is most available when it is least needed and least available when it is most needed, drawing directly on Minsky's observation that the system appears safest precisely when it is most vulnerable (Baker, 2012). The cross sectional dimension or interconnectedness addresses the risk of a spillover effect from individual systemically important institutions or the risk of common exposures of individual institutions on the system as a whole. The interconnectedness enables the amplification and spread of a shock to an individual institution to the whole financial system. In addition, the interaction between the cyclical and the interconnectedness can intensify the vulnerabilities (Claessens et al., 2012).

6.2.2 Macroprudential policy instruments

TEs have employed a variety of macroprudential instruments to address both dimensions of systemic risk throughout the period, yet their effectiveness is uncertain. These instruments can be credit-related, liquidity related, and capital related. Lim et al. (2011) identified ten instruments that have been most frequently used to achieve macroprudential objectives. These are listed in Table 6.1.

Table 6.1 The most frequently used macroprudential policy instruments

Macroprudential policy instruments	
Caps on the loan-to-value (LTV) ratio	Limits on maturity mismatch
Caps on the debt-to-income (DTI) ratio	Reserve requirement
Caps on foreign currency lending	Countercyclical capital requirements
Ceilings on credit or credit growth	Time-varying/dynamic provisioning
Limits on net open currency positions	Restrictions on profit distribution

Source: author based on Lim et al., 2011

The use of the instruments listed above across countries differs in the manner employed. They can either be used individually, where one instrument is employed to address a certain risk or together when a number of instruments are employed to address a certain risk. An example of the latter would be countries that have set limits on foreign currency lending and differentiated reserve requirements on a currency basis. Another distinction recognized in practice is that instruments can be employed in a broad manner or they can be targeting a specific risk. For example, some countries have imposed limits on foreign currency lending to address specifically foreign currency lending as a contributor to the increased interconnectedness dimension of systemic risk. They can also be fixed or time varying, where the time varying are designed to adjust to different phases of the cycle. In addition, the instruments can be employed as a rule or can be left at the discretion of the regulatory authority. Finally, they can be employed as a standalone policy or can be employed in conjunction with monetary and fiscal policies (Lim et al., 2011).

6.2.3 Macroprudential policy empirical review

The literature on macroprudential policy has not yet reached a clear consensus on the role of the different instruments. Furthermore, the empirical literature on macroprudential instruments is limited, mostly due to a scarcity of data as they have

become standard policy tools only in recent years. However, recently increasing efforts have been made to fill this gap. Studies have been able to investigate, to a certain degree, the effectiveness of the macroprudential policy instruments using data from the IMF's Global Macroprudential Instruments of 2010 and 2011, or by collecting their own primary data. The vast majority of these studies investigate the effectiveness of the macroprudential policy from the banking sector's perspective. A number of them focus on their effectiveness with respect to the housing sector (Vandenbussche et al., 2012; Kuttner and Shim, 2012; Crowe et al., 2011; Ahuja and Nabar, 2011). Most of them investigate their impact on accelerated credit growth or credit busts as measures of financial (in)stability (Dell' Aricia et al., 2012; Wong et al., 2011; Tovar et al., 2012; Lim et al., 2011). A very limited number of studies (Claessens et al., 2014; Ghosh, 2013) investigate the effectiveness macroprudential policy from the individual bank's perspective.

Vandenbussche et al. (2012), investigate the impact of macroprudential policy on house price inflation in 16 CESEE countries using quarterly data from the early 2000s to the end of 2010 employing panel techniques. They group macroprudential policy instruments into 29 categories, including a number of instruments related to foreign currency, given the high levels of euroization in these countries. They find that capital requirements and marginal reserve requirements on foreign funds had an effect on house price inflation. Kuttner and Shim (2012) also investigate the degree of effectiveness of macroprudential instruments in mitigating housing price and credit cycles using data from 57 countries and employing panel techniques. They find that caps on loan-to-value (LTV) and debt-to-income (DTI) ratios attenuate housing credit growth and are related to lower house price inflation. Crowe et al. (2011) explore the effects of these instruments on real estate booms and busts, and find caps on loan-to-value (LTV) ratios related to the real estate cycle have the best chance to curb a real estate boom, whilst dynamic provisioning, although ineffective in avoiding the boom, can help during the bust. Ahuja and Nabar (2011) investigate effectiveness of the measures in 49 emerging and advanced economies using quarterly data from 2000 to 2010 employing panel techniques. They find that LTV caps together with DTI caps slow property lending growth, which leads to lower inflation.

Dell' Aricia et al. (2012) investigate the effect of such policy instruments on mitigating credit booms and busts, using cross-country analysis in panel data regressions, and

find them effective. They find macroprudential policy helpful in reducing the incidence of credit booms and in decreasing the probability that booms end badly. Wong et al. (2011) investigate the policy effectiveness using panel data across 13 economies and find caps on LTV ratios effective in mitigating boom and boost cycles. Tovar et al. (2012) analysed the role and effectiveness of macroprudential tools in Latin American countries in the aftermath of the global financial crisis. They conclude that the employment of macroprudential tools has only a modest and transitory effect on the growth of credit in the private sector. In contrats, Lim et al. (2011), using cross-country analysis in panel data regressions, explore the role of macroprudential policy instruments on credit and leverage growth, and find them effective in reducing their procyclicality. Specifically, they find instruments such as caps on LTV and DTI, credit growth ceilings, reserve requirements and dynamic provisioning the most effective instruments.

Claessens et al. (2014) investigate the effectiveness of macroprudential policy using bank level data on more than 2,800 banks over the period 2000-2010 in 48 countries (both advanced and emerging). They employ nine specific macroprudential instruments including limits on foreign lending. They find that caps on DTI and LTV ratios, limits on credit growth and foreign currency lending are effective in reducing asset growth. Overall, they do not find evidence that the effectiveness of these tools varies by the intensity of the cycle. Ghosh (2013) investigates how macroprudential policy affect the performance of the banking sector across bank ownership, using an unbalanced panel with a minimum of 58 banks and maximum of 64 banks in India during 1999-2012. He finds that different instruments exert a differential impact on banks across ownership and addresses the differences as the outcome of different business modes, product sophistication, and risk appetite.

The existing empirical literature finds macroprudential policy instruments effective in attenuating overall credit growth and sectorial credit growth depending on their use. Moreover, a few studies found that besides mitigating the credit booms, these instruments can decrease the probability that booms end badly. Even though macroprudential polices can be powerful tools in mitigating systemic risk, they also impose certain costs. Classenss et al. (2014) argue that they affect resource allocation and more importantly they can limit efficient financial sector development. The existing literature on macroprudential policy instruments mainly advocates their

effectiveness in mitigating the systemic risk across countries but largely ignores the costs that they entail. One exception here is the study by Benigno et al. (2011) investigating the implications of macroprudential policy using a two-sector small open economy model, using quarterly Mexican data. They argue that such policy aimed at reducing the amount of borrowing or the probability of crisis might be counterproductive, suggesting that the distortionary costs imposed by them may be bigger than the benefit of eliminating the probability of crisis events. They provide evidence that employing macroprudential policy in tranquil times could be welfare reducing, because despite reducing the crisis probability, these polices reduce the average level of consumption.

In conclusion, to the best of our knowledge, the existing macroprudential literature has ignored the impact of macroprudential dimension on financial euroization. Most of the empirical literature on the macroprudential policy, although it usually covers transition economies in which the degree of financial euroization is high and can increase systemic risk in the interconnectedness dimension, is either focused on investigating its impact on the overall accelerated credit growth or specifically on the growth of housing sector credit. We extend this work by investigating how this policy may affect the levels of financial euroization, thus we analyse the role of macroprudential policy in limiting the interconnectedness dimension of the systemic risk in these countries.

This investigation contributes to the empirical discussion on macroprudential policy by focusing on a particular set of instruments related to foreign currency. We focus on these measures because, first, they directly address foreign currency lending therefore, it is expected that they affect financial euroization. Second, the qualitative investigation presented in the previous chapter indicated that these instruments are becoming an important driver of de-euroization. Third, these instruments are some of the most commonly used instruments of macroprudential policy in TEs. In addition, although in the existing macroprudential literature these instruments are controlled for and found significant in affecting the growth of the overall credit or housing sector credit, to the best of our knowledge their impact on the levels of credit euroization has not been studied. Furthermore, the macroprudential dimension has not caught the attention of the financial euroization literature either. To the best of our knowledge, the existing studies do not control for this policy when investigating the

determinants of financial euroization. There is a paper that looked at the impact of government policies in related area prior to the macroprudential area: Rosenberg and Tirpak (2008). They investigate the determinants of credit euroization in 10 CEE countries using data from 1999-2007 through OLS techniques. They also control for a FX restriction index, which they construct relative to regulatory restrictions with regard to financial euroization. The index takes into account regulatory restrictions aimed at slowing foreign currency borrowing such as whether central banks monitor FX risk, whether banks disclose FX risk to customers, etc. They find that these requirements have had only limited success. However, the study is limited in the sense that firstly it is conducted prior to the global financial crisis, which introduced the need for macroprudential policy. Thus even though some instruments that are now considered macroprudential policy instruments were employed even before the GFC, they were not employed or calibrated to address the exposure of the whole financial system to systemic risk. Second they put all these different instruments into one index and assume that each additional requirement with regard to credit euroization has the same effect. Third the study covers only 10 CEE countries and employs simple OLS techniques.

6.3 Model Specification

This section provides a critical discussion of the choice of measures for the model specification, which draws on the analysis undertaken in Chapter 2 and the present chapter.

6.3.1 The dependent variable: euroization measure

In the empirical investigation presented in this chapter, credit euroization is used as the dependent variable. The definition of the measure and the appropriateness of using it in the empirical investigation are considered below.

As discussed in the literature review of euroization in Chapter 2, until recently studies that examined financial euroization only concentrated on deposit euroization. This was considered reasonable given that it was thought that both credit and deposit euroization often mirror each other, mostly due to prudential regulations in many countries (Levy Yeyati, 2004). However, later it was argued that credit and deposit

euroization do not always match and often display different patterns (Ize and Levy Yeyati, 1998; Catao and Terrones, 2000; and Basso et al., 2011). Given the purpose of this investigation is to explain the impact of macroprudential policy on financial euroization and the instruments of interest are directly linked to credit euroization this seems to be a more appropriate measure. Therefore, the dependent variable used in the investigation is the share of loans in foreign currency in total loans in the financial system.

6.3.2 The independent variables of interest: macroprudential policy instruments

In the investigation presented in this chapter, the main contribution is looking at the impact of macroprudential policy on financial euroization. As discussed in the literature review presented above, during the last decade, TEs have employed a wide range of macroprudential policy instruments among which are a number of instruments related directly to foreign currency positions. Ideally, we would employ all individual macroprudential policy instruments, since all of them can potentially affect the level of euroization and it would be beneficial from the policymaking point of view to identify which instruments are effective. However, employing all variables would exhaust most or all of the degrees of freedom associated with the dataset, so we must find a compromise solution. Studies that investigate the macroprudential policy usually include a few instruments separately and decide to use in their final model the significant ones. Sometimes they include a large number and then drop insignificant ones to save degrees of freedom. Although this is a practical approach, it can be problematic in identifying the best instruments given that they are likely to be highly correlated.

Most of the studies investigate this policy through dummy variables, which take the value of one when the instrument is introduced and zero, otherwise. An exception is the study of Vandenbussche et al. (2012) who investigate the intensity of policy change through a complex coding system and Federico et al. (2012) who take into account the frequency of changes of certain policies. In this investigation, we will initially employ through simple dummy variables a few of the macroprudential policy instruments related to financial euroization directly introduced by TEs during the 2000-2013 periods, presented below in Table 6.2.

Table 6.2 Number of macroprudential policy instruments related to FC employed in TEs, 2000-2013

	Limits on FC loans	Limits on FC open posit.	Counter-cyclical capital buffers FC	Dynamic loan-loss provis. FC	Caps on FC LTV	Caps on FC DTI	Different Reserve require. for FC	Higher RWA for FC	Sum
Albania	1	1	0	0	0	0	0	1	3
Armenia	0	1	0	0	0	0	1	1	3
Azerbaijan	0	1	0	0	0	0	0	1	2
Belarus	0	0	0	0	0	0	1	1	2
B & H	0	1	0	0	0	0	0	0	1
Bulgaria	0	0	0	0	1	0	0	1	2
Croatia	0	1	0	0	0	0	1	1	3
Czech Rep	0	0	0	0	0	0	0	0	0
Estonia	0	1	0	0	0	0	0	1	2
Georgia	0	1	1	0	0	0	1	1	4
Hungary	0	0	0	0	1	1	0	1	3
Kazakhstan	0	1	0	0	0	0	1	1	3
Kosovo	0	1	0	0	0	0	0	0	1
Kyrgyz	0	1	0	0	0	0	0	0	1
Latvia	0	1	0	0	1	0	0	1	3
Lithuania	0	1	0	0	1	1	0	0	3
Macedonia	1	1	0	0	0	0	1	0	3
Moldova	1	1	0	0	0	0	0	0	2
Poland	1	0	0	0	1	1	0	1	4
Romania	1	1	0	0	1	1	1	1	6
Russia	0	1	0	0	0	0	1	0	2
Serbia	1	1	1	0	1	1	1	1	7
Slovak	0	0	0	0	0	0	0	0	0
Slovenia	0	0	0	0	0	0	0	0	0
Tajikistan	0	1	0	1	0	0	1	1	4
Ukraine	1	1	0	0	0	0	1	1	4
Sum	**7**	**19**	**2**	**1**	**7**	**5**	**11**	**16**	

Source: central banks, IMF Global Macroprudential Policy Instruments database, 2014

Table 6.2 provides a snapshot of the number of macroprudential policy instruments employed in the countries in our sample, which is used to argue the decision to pursue the analysis using only few of these measures. As discussed above the wide set of macroprudential policy measures were initially filtered to identify instruments that are directly related to financial euroization. The table distinguishes between eight macroprudential instruments related to foreign currency: (i) limits on foreign currency loans, (ii) limits on foreign currency positions, (iii) countercyclical capital buffers with regard to foreign currency loans, (iv) dynamic loan-loss provisioning for foreign currency loans, (v) loan-to-value (LTV) ratios with regard to foreign currency

loans, (vi) debt-to-income (DTI) ratio with regard to foreign currency loans, (vii) reserve requirements with regard to foreign currency funds and (viii) higher capital for risk weighted assets in FC.

Then the variation between countries and instruments was analysed to avoid instruments that may have little variation and thus be problematic to investigate with this set of countries. We can see that from our sample Serbia is the country with the highest number of instruments introduced, followed by Romania. In contrast, three countries: the Czech Republic, Slovakia, and Slovenia have not introduced any instruments related to foreign currency positions. Most countries have introduced at least one instrument. Limits on foreign currency positions is the most used instrument, introduced in 19 countries, followed by limits on foreign currency loans introduced in 7 countries. Dynamic loan-loss provisioning for foreign currency loans and countercyclical capital buffers with regard to foreign currency loans are the least used instruments, introduced in only one and two countries, respectively. Thus given the data constraints we will initially focus on the impact of the most used instruments. Finally, the degree of correlation between the instruments must be investigated given that, as discussed above, possible high correlation between the macroprudential instruments could be problematic in identifying the best instruments. In this analysis, this does not seem to be a problem for most of the macroprudential policy instruments taking into consideration that correlation indices between the macroprudential instruments included in the final model specification seem to be much lower than 0.5. (see Appendix 6.1). The only exception seem to be the correlation between the caps on LTV and caps on DTI which is slightly higher than 0.5. However, this is to be expected given that most countries have introduced them together. In the final model specification it was decided to keep the caps on LTV ratio given that it was used slightly more often.

In conclusion, it was decided to investigate the impact of the following macroprudential policy instruments, (i) limits on FC lending, (ii) limits on FC open positions; (iii) caps on FC LTV ratio and (iv) risk weighted assets in FC, on the level of credit euroization. Limits on FC lending is one of the tightest macroprudential policy instruments. If a country introduces an explicit limit on foreign currency, this should a have a negative impact on the level of credit euroization. The limits on FC open positions could be expected to have either a positive or negative impact depending on

the structure of banks' balance sheets. Introducing limits with regard to open positions in foreign currency would have a positive impact on the level of the credit euroization if banks have liabilities in foreign currency to begin with. This is most likely the case in TEs given the high level of deposit euroization. On the other hand, if banks do not have liabilities in foreign currency the introduction of limits would drive down the level of credit euroization. Caps on the LTV ratio restrict banks' lending in foreign currency in comparison to the value of collateral. By restricting the riskier lending which would have higher return this is expected to negatively impact the level of credit euroization if credit euroization is mostly supply driven. If the opposite holds, i.e. credit euroization is more demand driven, the instrument might be ineffective. The same applies to the last instrument RWA which increases the requirement for capital holding for riskier assets in FC.

Table 6.3 Definition of Macroprudential Policy Instrument Variables

Variables	Definition	Exp. sign
Limits on FC lending **(FC_lim)**	Dummy variable (0= if the instrument is not employed; 1=otherwise)	-
Limits on FC open positions **(FC_op_lim)**	Dummy variable (0= if the instrument is not employed; 1=otherwise)	+
Caps on LTV ratio **(FC_LTV)**	Dummy variable (0= if the instrument is not employed; 1=otherwise)	-
Different risk weighted assets_ **(FC_RWAl)**	Dummy variable (0= if the instrument is not employed; 1=otherwise)	-

There are some concerns about modelling these macroprudential policy instruments as dummy variables. For the first two, the limits on FC loans and FC open position, dummy variables are likely to be a more adequate modelling strategy to capture their possible effect on the level of credit euroization, given their simple nature and taking into account that they are the tightest/strictest instruments that most likely will have a strong immediate impact once introduced. However, the same does not necessarily apply to the next two, the caps on LTV ratios related to FC and the different risk weighted assets in terms of FC. These instruments are of much more complex nature in comparison to the first two and not as strong. In addition, whilst the first two are designed to affect the level of credit euroization, the second two are designed to affect the growth of credit euroization, which might make it more difficult to capture their impact.

6.3.3 The independent control variables: drivers of euroization

The review of the literature on euroization in Chapter 2 has identified factors that are expected to affect euroization in TEs on the theoretical basis. Drawing on these discussions, a list of key independent variables to be included in the model is now provided, together with a critical discussion of the respective measures available. We then focus on the main contribution of our work looking at the impact of macroprudential policy on financial euroization.

- **Interest rate differential**

The interest rate differential between the foreign and domestic currencies is the predominant explanatory variable in the empirical literature. It reflects the relative price of foreign currency loans, hence a higher interest rate differential, i.e. a lower interest rate on foreign currency loans, ceteris paribus, means lower costs for FC loans and thus increased demand (Zettelmeyer et al., 2010; Cuaresma et al., 2013). In addition, the differential reflects macroeconomic stability and its significance depends upon the trade-off effect between the currency risk and real interest rate risk if the inflation is lower than expected (Cuaresma et al., 2013; Hake et al., 2014). However, the empirical literature presents mixed results on the matter. A range of studies find a positive impact of the interest rate differential on credit euroization (Rosenberg and Tirpak, 2008; Neanidis and Savva, 2009; Basso et al., 2011). In contrast to them, using firm level data, Brown et al. (2011) do not find a significant positive relationship. Similarly, Cuaresma et al., (2013) find that interest rate differential does not influence credit euroization in these countries. Hake et al. (2014) find the interest rate differential significant in explaining credit euroization in Latin America, but insignificant in CESEE countries.

- **Deposit euroization**

Bank currency matching is one of the main determinants of credit euroization (Basso et al., 2010; Luca and Petrova, 2003; Ize and Levy Yeyati, 2003; Neanidis and Sava, 2009; Haiss et al., 2009; Ivanov et al., 2011; Haiss and Rainer, 2012). Banks also are constrained by the regulatory authorities to have large currency mismatches on their balance sheets therefore, they engage in currency matching (Calvo, 2001; Luca and Petrova, 2003; Ozsoz et al., 2010; Haiss and Rainer, 2012). This entails matching of

foreign currency positions or hedging against exchange rate risk by lending in foreign currency. This way the banks shift the risk to the customers (at least to some extent depending on the clients' hedging possibilities, see section 2.4) and decrease their exposure to currency risk. Whilst some argue that this happens only in the short run (Neanidis and Sava, 2009), others find it a long-term determinant (Ivanov et al., 2011). Brown and De Haas (2012) argue that besides banks, borrowers also are focused on matching their currency deposits with loans, which according to Cuaresma et al. (2013) is also strengthened by the large share of remittances in some of the Central and East European countries. Lending in foreign currency is the only possibility for banks to hedge against currency risk given the lack of hedging instruments in the countries due to underdeveloped banking systems and lack of financial markets.

- **Exchange rate volatility**

Theoretically, the impact of exchange rate volatility on credit euroization can be positive or negative given that it affects the behaviour of both lenders and borrowers (see section 2.5.2). Likewise, the results of the empirical literature are mixed. Rosenberg and Tripak, 2008; Cuaresma et al., 2013 find a negative effect on credit euroization. A few studies (Bajaras and Morales 2003; Luca and Petrova, 2008) conclude that exchange rate volatility impacts negatively credit euroization only in the short run. In contrast, Ivanov et al. (2011) and Honig, (2009) find a positive effect in the long run.

- **Inflation volatility**

Inflation volatility has been found to be significant in explaining credit euroization. Its influence depends on the trade-off effect between currency risk and interest rate risk, see section 2.5.2. Consequently there are studies that find a positive impact on credit euroization (Zettelmeyer et al., 2010; Cuaresma et al., 2013) and those that find a negative impact (Steiner, 2011).

- **Minimum Variance Portfolio- MVP**

The portfolio theory view highlighted the MVP as a key driver of credit euroization (see section 2.3.2). It stipulates that the higher the variability of inflation relative to real exchange rate depreciation, the riskier and less attractive the domestic currency

assets, inducing credit euroization. A low and stable domestic inflation rate, and volatile exchange rate should increase the preference for the domestic currency as store of value (Rennhack and Nozaki, 2006). The empirical literature mostly reports a positive impact of the trade-off between exchange rate variability and inflation on credit euroization (Ize and Levy Yeyati, 2003; De Nicolo et al., 2005, Basso et al., 2010; Scheber and Stix, 2009; Barajas and Morales, 2003; Luca and Petrova, 2008; Ivanov et al., 2011).

- **Institutional quality**

The institutional approach maintains that institutional failures and a low quality institutional framework can encourage and enhance euroization (see section 2.3.4). The empirical literature also finds that a lack of institutional quality and credibility (particularly in the banking sector) induces credit euroization (Ize and Parrado, 2002; Feige, 2003; Jeanne, 2003; Luca and Petrova, 2003; Scheber and Stix, 2009; Stix, 2009; Neanidis and Sava, 2009; Zettelmeyer et al., 2010).

- **Access to foreign funds**

Theoretically, it is expected that easier access to foreign funding positively affects credit euroization. In line with theory most of the studies find that access to parent bank funding in foreign currency has a positive impact on credit euroization (De Haas and Van Lelyveld 2006, 2010; Basso et al., 2011; Haiss and Rainer 2012). However, there are few studies that find a negative relationship between foreign banks and credit euroization, (Brown and De Has, 2012) or simply do not find a significant relationship (Luca and Petrova, 2008; Brown et al., 2011).

- **Other control variables**

Following the literature, when conducting a cross country investigation it is important to include in the model specification controls for different country characteristics to reduce possible endogeneity. We consider including variables that have often been used in recent studies such as GDP growth, GDP per capita and financial deepening to control for the business cycle, size of the economy and development of the financial sectors across countries.

These independent variables are summarized below in Table. 6.4, which provides the detailed definitions to be used in this study and the expected sign.

Table 6.4 The detailed description of independent variables

Variables	Definition	Exp. Sign
Credit Euroization **(Credit_FE)**	Share of Loans in Foreign Currency to Total Loans	Dependent variable
Deposit Euroization **(Deposit_FE)**	Share of Deposits in Foreign Currency to Total Deposits	+
Interest rate differential **(IntRate_diff)**	The difference between interest rates on Foreign loans to Domestic Loans (in p.p)	+/-
Inflation volatility **(Inf_vol)**	Standard deviation over the period	+
Exchange rate volatility **(Err_vol)**	Standard deviation over the period	+/-
Minimum variance portfolio **(MVP)**	Standard deviation of inflation over standard deviation of Exchange rate	-
Banking Sector Regulatory Indicator **(BSRI)**	EBRD index	-
Foreign Ownership **(FO)**	Asset share of foreign owned banks in banking sector	+/-
GDP growth **(GDP_g)**	Annual GDP growth	-
GDP per capita **(GDP_c)**	GDP per capital	-
Financial deepening **(FD)**	Domestic credit to private sector by banks (% of GDP)	-

6.4 Data

In the analysis of the impact of macroprudential policy on financial euroization in TEs in this chapter, we employ panel data with annual frequency obtained from different databases. The data spans a period from 2007 to 2013, and covers 25 countries namely Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Georgia, Hungary, Kazakhstan, Kosovo, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, the Slovak Republiv, Slovenia, Tajikistan, and Ukraine. Panel data offers the advantage of "more variability, less collinearity among variables, more degrees of freedom and more efficiency" (Baltagi, 1985, p. 4). That this is a panel with a relatively small number of cross sectional

groups and not a long time dimension is of some concern when choosing the appropriate estimator (for further discussion see section 6.5).

The choice of countries within European transition economies and the time span covered in this empirical analysis were determined by data availability. Covering the aftermath of the global financial crisis, while investigating the determinants of financial euroization and accounting for the macroprudential dimension, is particularly interesting. As discussed in the section 1.4 in Chapter 1, during this period financial euroization was already widespread in TEs, in many countries reaching a peak before the global financial crisis, making this period well suited to investigate the determinants of the financial euroization. In addition, the macroprudential policy was mostly pursued in these countries during this period (see section 6.1). Therefore, this database is well suited to investigate the macroprudential dimension. Given that some countries are missing data for certain years the panel is not balanced.

The macroprudential data in this investigation are obtained from IMF surveys, central banks, and Claessens et al. (2014) and Vandenbussche et al. (2012) papers. In addition, the data set was enriched with additional information thanks to the Vandenbussche et al. (2012) who provided us with the updated version of their data set on macroprudential measures employed in 15 of the countries in our sample covering the 2000-2010. The data on the other explanatory variables are obtained from different sources, including the International Monetary Fund, World Bank, European Bank for Reconstruction and Development, and central banks.

Table 6.5 Variables and the sources they are obtained from

Variables		Source
Limits on FC lending	**(FC_lim)**	Central banks; IMF, 2014; Claessens et al. (2014); Vandenbussche et al. (2012)
Limits on FC open positions	**(FCop_lim)**	Central banks; IMF, 2014; Claessens et al. (2014); Vandenbussche et al. (2012)
Caps on LTV ratio	**(FC_LTV)**	Central banks; IMF, 2014; Claessens et al. (2014); Vandenbussche et al. (2012)
Different risk weighted assets	**(FC_RWA)**	Central banks; IMF, 2014; Claessens et al. (2014); Vandenbussche et al. (2012)
Credit Euroization	**(Credit_FE)**	Central banks;
Deposit Euroization	**(Deposit_FE)**	Central banks;
Interest rate differential	**(IntRate_diff)**	EBRD; central banks
Inflation volatility	**(Inf_vol)**	World Bank
Exchange rate volatility	**(Err_vol)**	World Bank
Minimum variance portfolio	**(MVP)**	World Bank
Banking Sector Regulatory Indicator	**(BSRI)**	EBRD
Foreign Ownership	**(FO)**	EBRD
GDP growth	**(GDP_g)**	World Bank
GDP per capita	**(GDP_c)**	World Bank
Financial deepening	**(FD)**	World Bank

Descriptive Statistics

The descriptive summary of the variables used in model is given in Table 6.6. As the table shows there is a considerable variation in most of the variables.

Table 6.6 Descriptive Statistics

Variable	Mean	ST Dev	Min	Max
Credit Euroization	0.498	0.235	0	0.94
Deposit Euroization	0.418	0.203	0.2	0.85
Interest rate differential	3.142	4.612	-6.57	25.88
Inflation volatility	1.947	3.858	0.13	35.22
Exchange rate volatility	0.004	0.009	0	0.07
Minimum variance portfolio	4.15e+	2.00e+	0	1.40e+
Banking Sector Regulatory Indicator	3.033	0.619	2	4.33
Foreign Ownership	0.636	0.299	0.07	0.99
GDP growth	2.749	5.371	-17.95	25.05
GDP per capita	8997.432	6211.711	523.06	26989.7
Financial deepening	48.519	21.724	10.9	106.35

6.5 Empirical approach

In investigating the impact of macroprudential policy on financial euroization it is important to account for the dynamics of the relationship based on inertia. The behaviour of households in depositing their money in foreign currency or requiring loans in foreign currency, and banks in offering loans in foreign currency is expected to change slowly. This is because of the force of habits i.e. psychological reasons: households are creatures of habit and react slowly to changes in the market. Additionally, the slow reaction can be attributed to potential high costs attached to making changes. Therefore, both households and banks can wait until stimulated enough to justify the cost of reacting. Banks can continue to offer loans in foreign currency through attractive interest rates until stimulated enough by a significant change in the households' behaviour in depositing in foreign currency, or government policy in pushing for or encouraging local currency. Omitting dynamics introduces bias and therefore leads to inconsistent estimates of the effects of the variables of interest, even when the dynamic effect is not of direct interest (Bond, 2002). Moreover according to Greene (2008), in presence of dynamics, the variables of interest only measure the impact of the new information which still is conditional of the past, thus dynamics should be modelled. Consequently, we dismiss static panel models apply with dynamic panel models, which enable the inclusion and exploitation of the adjustments explicitly in the model.

The simplest way of accounting for dynamics is modelling it within the estimated part of the model thorough inclusion of the lagged value of the dependent variable. However, such a model cannot be estimated without problems through OLS, or conventional FE and RE estimators. The lagged dependent variable is correlated with the error term, thus there is the problem of endogeneity. These estimators would be biased, inconsistent, and inefficient. Unlike OLS, FE and RE, the system General Methods of Moments (GMM) estimator accounts for potential endogeneity problem by instrumenting from within the sample the variables that are not strictly exogenous by using lagged levels and (their lagged differences as instrumental variables. This estimator does not require distributional assumptions and can allow for heteroscedasticity of unknown form (Verbeek, 2000, pp. 143 and 331; Greene, 2002, pp.201, 525 and 523). However, it must be noted that GMM estimators are designed for panels with a wide cross-section (N) and short time series (T). Arellano and Bond

(1991) had a panel with N=140 and T=7 whereas, Arellano and Bover (1995) had N=1306 firms and T= 4. According to Greene these estimators require as few as three periods of data to be usable, although 'four or more will be preferable' (Greene, 2007, E11-83). Roodman (2006, p.35) suggests that cross-sectional groups ought to be at least more than 20 (N > 20). Although with N=25 and T=7 we meet his absolute minimum requirements, the size of the cross section is a problem that we are aware of throughout this investigation and will return to.

A problem when employing system GMM with relatively small samples is the overfitting bias. In small samples too many instruments which "by virtue of being numerous, can overfit endogenous variables, failing to expunge their endogenous components and biasing coefficient estimates towards those from non-instrumenting estimators" (Roodman, 2009, p.6). Too many instruments can weaken the Hansen test of overidentifying restrictions, which is relied upon to test the validity of instrument. The literature does not provide a clear guidance on the size of this bias but it shows that in small samples the biasedness of these estimators rises with the increasing number of instruments relative to the number of cross-sectional groups (Arellano, 2003; Windemeijer, 2005; Roodman, 2009).

As a first model, we initially specify a dynamic panel model that includes explanatory variables described earlier, the structure of which is presented below (Equation 6.1). It is important to note that, given our small sample, it was not possible to include all control variables without sacrificing too many degrees of freedom. Thus, in terms of control variables it was decided to keep EBRD's banking sector reform index as the only control variable for the development of the financial sectors and size of the economy (expecting that bigger economies have more developed financial sectors). In addition, the minimum variance portfolio (MVP) when included is collinear with inflation and exchange rate volatility, therefore it was excluded.

In the first model, we treat all independent variables as exogenous with the exception of the lagged values of the dependent variable.

$$y_{it} = \alpha_0 + \alpha_1 y_{it-1} + \alpha_1 y_{it-2} + \beta_1 x_{it} + \lambda T_t + u_{it} \qquad \textbf{(6.1)}$$
$$u_{it} = v_i + e_{it}$$

Where i = 1..., N indexes the cross-section groups, in this case countries and t = 1,..., T indexes the time periods, in this case years from 2007 to 2013. The dependent variable i.e. credit euroization is y_{it} , and y_{it-1} and y_{it-2}, respectively, represent the first and second lags of credit euroization. α_1, α_2 are parameters; and β_1 , λ are vectors of parameters to be estimated. The χ_{it} is a vector of exogenous variables that do not depend on the current or past errors and T_t is a vector of year dummies. Taking into consideration that in this model we are treating all dependent variables, except of the lagged dependent variables, as exogenous thus the χ_{it} vector includes deposit euroization (Deposit_FE); the interest rate differential (IntRate_diff); inflation volatility (Inf_vol); exchange rate volatility (Err_vol); banking sector reform index (BSRI); foreign ownership (FO); and our variables of interest, the macroprudential policy instruments (FC_lim; FC_op_lim; FC_LTV; FC_RWA).

Finally, u_{it} represents a composed error term, made up of two components: v_i i.e. the group-level, time invariant effects, which control for all unobserved influences on credit euroization, and e_{it} i.e. the observation-specific term that varies over both groups and time and includes the general ignorance of the determinants of credit euroization.

Generally, the literature on euroization has not examined whether any of the independent variables is endogenous. Though, Kumamoto and Kumamoto (2014) suggest exchange rate volatility to be potentially endogenous, since in the presence of a high degree of euroization, money demand for the domestic currency depends on both domestic and foreign nominal interest rate, increasing the exchange rate volatility. However, for many of the countries in our sample exchange rate stability has been a policy objective of the government for many years, so it cannot be endogenous in those countries. In addition, some of the other countries under consideration have an active policy to reduce the exchange rate volatility (see section 1.2). Nevertheless, we investigate the possibility of exchange rate volatility influencing credit euroization in an unobservable manner by including it in the group-specific effect in one model specification.

In addition, the literature on macroprudential policy suggests that our main variables of interest, macroprudential policy instruments, may be influenced by credit euroization itself. According to Claessens et al. (2014, pp. 14) the probability that "macroprudential policy is adopted in response to the behaviour of the credit, is considerable... This implies a possible bias when studying the effects of macroprudential policy on these aggregate variables". However, regarding this possible endogeneity of macroprudential policy instruments, the timing of their introduction does not coincide with high euroization levels, since the degree of financial euroization has been high in TEs for at last two decades before the instruments were introduced.

As discussed above if potential endogeneity is present and is not accounted for, it leads to biased and inconsistent estimates, and can invalidate the results of econometric studies. Consequently, we specify other models with an almost identical structure to the (6.1) but in which these suspected variables are specified as endogenous.

$$y_{it} = \alpha_0 + \alpha_1 y_{it-1} + \alpha_1 y_{it-2} + \beta_1 x_{it} + \beta_2 w_{it} + \lambda T_t + u_{it} \quad) \qquad \textbf{(6.2)}$$
$$u_{it} = v_i + e_{it}$$

Where the only addition to the 6.1 model is w_{it} which represents a vector of endogenous covariates, all of which may be correlated with unobserved group-specific influences on credit euroization and therefore correlated with past and present error terms. In the (6.2a) model the w_{it} vector includes only the exchange rate volatility (Err_vol) as possibly endogenous and every other variable specified in the (6.1) model is treated exogenous. Whereas, in the (6.2b) model the w_{it} vector includes the exchange rate volatility (Err_vol) and our variables of interest i.e. the macroprudential policy instruments (FC_lim; FC_op_lim; FC_LTV; FC_RWA) as possibly endogenous, with everything else is treated as exogenous.

6.6 Empirical Results

This section discusses the appropriateness of the model and the empirical results. It begins with a discussion of the diagnostic checks and then it continues with

commenting of the results of the preferred model. The estimates were obtained using Roodman's (2006) user-written programme xtabond2.

Given the possible severity of the overfitting bias of GMM in small samples such as ours, and in absence of a clear theoretical guidance regarding the instruments set and the number of lags at any level of the model, choosing the best specification in relation to instruments is not straightforward. Whilst a larger number of instruments provide more information, the literature suggests that in small samples with a rising number of instruments relative to the number of cross-sectional groups, the bias of these estimators rises (Arellano, 2003; Windemeijer, 2005; Roodman, 2009). In his user-written programme xtabond2, Roodman (2006, p.13) issues a warning about the number of instruments being larger than the number of cross sectional groups 'as a minimally arbitrary rule of thumb'. In this regard the investigation was carried out following closely the general practice, which is to start with a fully specified model with the maximum number of instruments. Then, the number of instruments was reduced through limiting lags and the use of collapse command.

In Table 6.7 (with details in Appendix 6.2, 6.3 and 6.4), all the final model specifications satisfy Roodman's minimal rule of thumb, though only just (with model 6.2b having the number of cross sectional groups equal to the number of instruments). It must be noted that this is not a strong diagnostic check as the bias in the parameter estimates is expected to rise with fewer degrees of freedom; it only suggests that system GMM estimator cannot be immediately rejected.

Table 6.7 Number of groups vs. instruments in different specifications

Model specification	Model 6.1	Model 6.2a	Model 6.2b
No Cross sectional groups	25	25	25
No Instruments	20	21	25

Our final choice of the best model specification is based on the diagnostic checks of first and second serial correlation, the Sargan test, and the Hansen test. Table 6.8 below summarises the specifications tests for the three model specifications (6.1), (6.2a) and (6.2b), estimated with two-step System GMM, Windmeijer-corrected standard errors, using orthogonal deviations (see Appendices 6.2, 6.3, 6.4 for printouts of specification tests).

Table 6.8 Diagnostic checks of different specifications

Model specification	Model 6.1	Model 6.2a	Model 6.2b
Treating endogenous	-	Err_vol	Err_vol and MPIs
No of observations	173	173	173
Arellano-Bond test for AR(1) in first differences	z = -1.15 Pr > z = **0.251**	z = -1.30 Pr > z = **0.192**	z = -1.63 Pr > z = **0.103**
Arellano-Bond test for AR(2) in first differences	z = -1.17 Pr > z = **0.242**	z = -1.06 Pr > z = **0.289**	z = -1.19 Pr > z = **0.234**
Sargan test of overid. restrictions:	chi2(1)= 0.25 Prob > chi2 = **0.880**	chi2(6)= 0.30 Prob > chi2 = **0.959**	chi2(7)= 2.54 Prob > chi2 = **0.924**
Hansen test of overid. restrictions:	chi2(1)= 0.62 Prob > chi2 = **0.733**	chi2(6)= 1.17 Prob > chi2 = **0.760**	chi2(7)= 3.99 Prob > chi2 = **0.781**
Difference-in-Hansen tests of exogeneity of instrument subsets:			
GMM instruments for levels			
Hansen test excluding group:	chi2(1)= 0.38 Prob > chi2 = **0.536**	chi2(1)= 0.38 Prob > chi2 = **0.538**	chi2(1)= 0.30 Prob > chi2 = **0.583**
Difference (null H = exogenous):	chi2(1)= 0.24 Prob > chi2 = **0.625**	chi2(2)= 0.79 Prob > chi2 = **0.673**	chi2(6)= 3.69 Prob > chi2 = **0.719**
Gmm (lagcredit_fe, collapse lag(2 3))			
Hansen test excluding group:		chi2(0)= 0.00 Prob > chi2 = .	chi2(4)= 2.45 Prob > chi2 = **0.653**
Difference (null H = exogenous):		chi2(3)= 1.17 Prob > chi2 = **0.760**	chi2(4)= 1.53 Prob > chi2 = **0.674**
Gmm (ERR_vol, collapse lag(1 1))			
Hansen test excluding group:		chi2(1)= 0.30 Prob > chi2 = **0.582**	
Difference (null H = exogenous):		chi2(3)= 0.87 Prob > chi2 = **0.648**	

The GMM estimator does not require distributional assumptions and allows for heteroskedasticity, but it is consistent only if there is no second-order serial correlation in the error term of the first-differenced equation. As Roodman notes, GMM estimator uses lagged values as instruments, thus the error independence assumption is a crucial condition for the exogeneity and hence validity of the instruments (2009, p. 97). Consequently, the test for second order serial correlation

in the error terms serves as a test for the validity of the instruments as well. In this analysis, in all specifications the AR(2) test does not reject the null hypothesis of no second-order serial correlation at the 20 percent level, which is desirable in such diagnostic tests, also supporting the validity of the instruments introduced in the model specification (see Table 6.5). Besides the second order correlation, Smith argues to check for the first order serial correlation (m1 test) as well, as a robustness and reliability check of the m2 test (Smith, 2010, p. 13). Regarding the AR(1) test both specifications have problems because they do not reject the null hypothesis of no first order correlation as expected, but this test is regarded as having a subsidiary role to the AR(2) test. First-order serial correlation is expected in differences thus diminishing the role of the AR(1) test (Roodman, 2006, p.33).

Within the discussion of diagnostics checks in dynamic panel, Hansen and Sargan tests are used to test for over-identifying restrictions to validate the model specification. Sargan's test is considered a special case of the Hansen test, valid under the assumption of homoscedasticity. Nevertheless, given that heteroskedasticity is generally present in panel data (Roodman, 2006; p.11), studies rely more on the Hansen test, which is seen as a more robust test. In this analysis, the Hansen test yields p-values ranging between 0.73 and 0.78, which are within the lower and upper bounds suggested by Roodman (2007, 2009). Roodman notes that, as a rule of thumb, the Hansen test p-value should be at least 0.25 to indicate valid instruments (2007, p. 10) but less than 1, because that would suggests weakness of the test (2009, p. 10). In terms of the Sargan test which according to Roodman (2009) can also be used as a test of structural specification of the model, all models are well specified.

Another diagnostic check is the difference-in-Hansen tests of the exogeneity of instrument subsets. As seen in the Table 6.5 the critical values of these tests applied to the differences used to instrument the levels equation find insufficient evidence to reject the null hypothesis of valid over-identifying restrictions. Consequently, the system GMM is preferred to the difference GMM estimator.

The final diagnostic check is with regard to results of the lagged dependent variable. The results from all three model specifications confirm the usefulness of using a dynamic panel model, since the statistical significance is a simple validation of the presence of the dynamics in the estimated relationship (see Table 6.6). A credible estimate of the coefficient of the lagged dependent value should be a lower value than

1.00 because a higher value can "imply an unstable dynamics, with accelerating divergence away from the equilibrium values" (Roodman 2009, pp. 103) and all specifications meet this requirement. However, an important check is the comparison of the values of the estimated coefficient on the lagged dependent variable across three estimators: OLS, FE, and system GMM. According to Bond (2002) and Roodman (2009) good estimates of the true parameter of the coefficient of the lagged dependent variable are expected to lie in or near the credible range between the highest bound estimator obtained by OLS and the lowest bound estimator obtained by the FE estimator. They do not always do so because as Roodman points out "these numbers are themselves point estimates with associated confidence intervals" (2007, p. 18). On the other hand, being a little outside of the range is much better than being a lot outside. In this analysis, the coefficient obtained from FE estimator is the lowest bound, but the coefficient obtained from the OLS estimator is slightly lower than the coefficients obtained from the system GMM estimator. In this check all estimated coefficients obtained through the system GMM fall outside the range but the coefficient of the (6.2b) model specification is the closest to the range, followed by the (6.1) model. Thus, in this sense, the (6.1) and (6.2b) model specifications may be slightly preferable to the (6.2a) model.

Table 6.9 Comparison of coefficients FE, system GMM and OLS[11]

	FE	**System GMM**			**OLS**
		(6.1)	**(6.2a)**	**(6.2b)**	
Coefficient of lagged dependent variable (lagcredit_fe)	0.184	0.479	0.524	0.460	0.402
	(0.003)	(0.019)	(0.004)	(0.016)	(0.000)

In conclusion, there is little to distinguish which model specification is preferable in terms of diagnostics. All specifications are similar in terms of Hansen, Sargan and Hansen-in-difference tests. The (6.2b) model specification is marginally preferred in terms of the coefficient of the lagged dependent variable; however, although all specifications have a relatively low number of cross sectional groups compared to the number of instruments, this model has the lowest, increasing the concern of overfitting bias. Given the lack of a clear choice it seems reasonable to proceed by comparing the parameter estimates, which are detailed in Table 6.9.

[11] See Appendix 6.5 for the Stata Outputs

Table 6.10 below summarises the results of the three model specifications (6.1), (6.2a) and (6.2b), as estimated with two-step System GMM, Windmeijer-corrected standard errors, using orthogonal deviations (see Appendices 6.2, 6.3, 6.4 for printouts).

Table 6.10 Estimation results of different specifications

System GMM	**(6.1)**		**(6.2a)**		**(6.2b)**	
Variables	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|
			Credit_FE (dependent variable)			
Lagcredit_fe	**0.479*** **	**0.019**	**0.524*** **	**0.004**	**0.460*** **	**0.016**
Deposit_FE	0.286	0.132	0.257	0.135	0.003	0.993
IntRate_diff	0.005	0.133	0.005	0.153	**0.007** **	**0.039**
Inf_vol	0.002	0.521	0.002	0.527	0.005	0.235
Err_vol	-0.634	0.330	-1.146	0.408	2.600	0.240
BSRI	0.024	0.515	0.025	0.555	-0.008	0.897
FO	0.069	0.287	0.058	0.404	0.109	0.194
FC_lim	**-0.029***	**0.072**	**-0.028***	**0.093**	**-0.082** **	**0.043**
FCop_lim	**0.110*** **	**0.008**	**0.104*** **	**0.015**	0.198	0.306
FC_LTV	**0.106** **	**0.005**	**0.098** **	**0.011**	**0.152*** **	**0.012**
FC_RWA	0.010	0.618	0.006	0.739	**0.125*** **	**0.001**
D_2008	-0.004	0.932	0.002	0.961	-0.019	0.593
D_2009	-0.035	0.550	-0.021	0.728	-0.030	0.542
D_2010	-0.027	0.574	-0.022	0.688	-0.033	0.384
D_2011	-0.062	0.437	-0.057	0.530	-0.123	0.138
D_2012	-0.062	0.334	-0.056	0.456	-0.111	0.114
D_2013	-0.053	0.405	-0.046	0.539	-0.099	0.153
_cons	0.064	0.705	0.065	0.736	0.029	0.908
No. of observations	173		173		173	
No. of cross sectional groups	25		25		25	

Statistics with *, **, or *** are significant at 10%, 5%, or 1% level, respectively.

The estimated coefficients obtained through the system GMM dynamic approach only directly give the short-run impact i.e. the effect of the new information on determinants of financial euroization. As Greene (2008, p. 469) points out "with the lagged dependent variable, we now have in the equation the entire history of the right-hand-side variables, so that any measured influence is conditional on this history; in this case, any impact of (the independent variables χ_{it}) represents the effect of new information". In fact, in our models the relatively large size of the

estimated coefficient of the lagged dependent variable in comparison to other variables indicates that a large part of the effect of the entire time path of the other variables is being included in this variable, with this being a little more pronounced in the (6.2a) specification. In all specifications, this coefficient is positive, suggesting a persistence or inertia effect from previous financial euroization, as expected.

Overall, the results in terms of the significance, sign and size, are similar in the first two models, but there are some differences in the estimates of model (6.2b) in which the macroprudential policy instrument variables are treated as endogenous. The difference between model (6.2b) and the other two models are not always in line with a priori expectations, which might indicate that, as discussed in section 6.5, the grounds for treating macroprudential policy instruments as endogenous might be questionable. At this point we do not have a preferred specification and briefly compare and contrast all three. In the detailed consideration of the results that follow and in the next section, the interpretation of the estimates is on average, ceteris paribus.

Across three models, besides the lagged dependent variable, three out of the four variables of interest, i.e. the macroprudential policy instruments, are statistically significant. The estimated impact of the tightest macroprudential policy instrument, limits on foreign currency loans (FC_lim), which controls for if the country has introduced explicit limits on foreign currency lending on the level of credit euroization, is consistent across the specifications. The statistical significance of the variable varies from four percent in the (6.2b) model to nine percent in the (6.2a) model. The coefficient of this variable has a negative sign which is in line with the literature review and the findings of the qualitative study presented in the previous chapter. The introduction of explicit limits on foreign currency lending decreases the level of credit euroization by about 3 percentage points in models (6.1) and (6.2a), but the estimate is higher in model (6.2b) indicating a decrease ofabout 8 percentage points.

The other variable of interest, which is statistically significant and with the expected sign, is macroprudential policy instrument limits on foreign currency open positions (FCop_lim), which controls for if the country has introduced limits in foreign currency open positions. Thus, if limits are in place banks are expected to match their liabilities in foreign currency with assets on foreign currency. This variable is highly significant

at one percent, but only in the first two models: (6.1) and (6.2a). The coefficient of this variable has a positive sign which is in line with the literature review and the findings of the qualitative study presented in the previous chapter. The introduction of limits on foreign currency open positions increases the level of credit euroization by about 11 percentage points.

The third macroprudential policy instrument variable which controls for if the country has introduced caps on LTV ratios with regard to FC loans (FC_LTV), is also highly significant at the one percent level across the three models, but it consistently has an unexpected sign. The coefficient on this variable has a positive sign meaning that if the country has introduced caps on LTV ratios for foreign currency loans this increases the level of credit euroization. The introduction of caps on LTV ratios with regard to FC loans is estimated to increases the level of credit euroization from between nine and 15 percentage points. This is not line with previous expectation or with the findings of the analysis presented in the previous chapter.

The final macroprudential policy instrument variable, which controls for if the country has stricter classification for risk weighted assets in FC (FC_RWA), is only significant in the (6.2b) model, although there is significant at the one percent level. However, the coefficient on this variable also has an unexpected positive sign. If the country has introduced stricter classification for risk weighted assets in FC, the level of credit euroization increases by 13 percentage points. This is not line with previous expectation or with the findings of the analysis presented in the previous chapter.

What is striking about the results is the insignificance of the conventional drivers of credit euroization such as deposit euroization, inflation volatility, exchange rate volatility, and foreign ownership across all model specifications in spite of the high explanatory power of the three models[12]. In three models, at the conventional one, five and ten percent, all of these conventional drivers are statistically insignificant, the only exception being the interest rate differential in the third specification when we control for possible endogeneity of exchange rate volatility and macroprudential policy instruments. In the model (6.2b) the coefficient of the interest rate differential (IntRate_diff) is statistically significant at 4 percent, and has the expected sign. On average, ceteris paribus, 1 percentage point increase in the spread between the

[12] See Appendices 6.2, 6.3, 6.4

interest rates on loans in FC and DC increases the level of credit euroization by 0.7 percentage points. It is worth noting that the size of the estimate is consistently small across all specifications.

From the remaining conventional drivers of credit euroization, although statistically insignificant most of them such as deposit euroization (Deposit_FE), inflation volatility (Inf_vol), exchange rate volatility (Err_vol) and foreign ownership (FO) have the expected sign. The exception here is the banking sector reform index (BSRI) through which we are controlling for the quality of institutions, has the opposite sign than the a priori expected one.

As explained above, the coefficients discussed above explain the effect of the new information on the level of credit euroization. The long-run effects can be obtained by dividing the regressors by one minus the estimated coefficient on the lagged dependent variable. The estimated long-run coefficients for the models (6.1) (6.2a) and (6.2b) are presented in Table 6.10, presented below.

Table 6.11 Long-run coefficients of different specifications

System GMM	**(6.1)**		**(6.2a)**		**(6.2b)**	
			LONG RUN COEFFICIENTS			
Variables	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|
Deposit_FE	**0.550****	**0.021**	**0.541****	**0.042**	0.005	0.993
IntRate_diff	0.011	0.231	0.012	0.216	**0.014***	**0.106**
Inf_vol	0.004	0.559	0.005	0.559	0.009	0.323
Err_vol	-1.218	0.236	-2.410	0.380	4.816	0.303
BSRI	0.047	0.493	0.052	0.540	-0.014	0.899
FO	0.133	0.261	0.123	0.401	0.203	0.247
FC_lim	**-0.056***	**0.070**	**-0.058***	**0.100**	**-0.152****	**0.055**
FCop_lim	**0.212*****	**0.003**	**0.219*****	**0.007**	0.367	0.333
FC_LTV	**0.204*****	**0.000**	**0.207*****	**0.003**	**0.282****	**0.022**
FC_RWA	0.010	0.618	0.013	0.741	**0.232****	**0.026**

Statistics with *, **, or *** are significant at 10%, 5%, or 1% level, respectively.

In the long run the deposit euroization variable (Deposit_FE) is significant in the (6.1) and (6.2a) specifications at 2% and 4% respectively. On average, in both models in the long run, an increase of 1 percentage point in the level of deposit euroization is associated with a 0.5 percentage point increase in the level of credit euroization.

Again, macroprudential policy instruments are the only other factors that are found significantly affecting the level of credit euroization in TEs.

Given the discussion above and on the diagnostics, particularly bearing in mind the small number of groups compared to the instrument count in our estimations it is difficult to argue for a 'preferred' model. In addition, the slightest change of instrumentation did considerably change the results in terms of the estimated coefficients, see Appendix 6.6. This instability in terms of instrumentation might mean that the system GMM might not be the best estimator for our case, most likely because, as initially suspected, not having a wide enough cross section might be problematic given that these methods were devised for wide and short panels, although we did meet the absolute minimum criteria. Consequently, we turn to another possible method that allows modelling of dynamic economic relationships.

Autoregressive (AR) models

When the system GMM estimator is not the appropriate econometric approach, studies turn to autoregressive (AR) models which enable the modelling of dynamics in the error term. These models are commonly used in the literature on determinants of financial euroization (see section 2.5.2). In AR models the slope coefficients of the static panel model are estimated conditional on the dynamics modelled in the errors (Cochrane-Orcutt, 1949).

First step

We start with a first order autoregressive model without a lagged dependent variable, (for simplicity with only one independent variable):

$$y_{it} = \alpha_0 + \beta_1 x_{it} + u_{it} \quad \textbf{(6.4)}$$

$$u_{it} = \sigma u_{it-1} + e_{it} \quad \textbf{(6.5)}$$

Where all other variables are defined the same as **(6.3)** but the u_{it} represents the error term containing the dynamic effect, that is taken into account by σ and which lies between 0 and 1.

Second step

Lagging each component of this model once leads to:

$$y_{it-1} = \alpha_0 + \beta_1 x_{it-1} + u_{it-1} \quad \textbf{(6.6)}$$

Third step

Solving **(6.6)** for the lagged error term u_{it-1} we get:

$$u_{it-1} = y_{it-1} - \alpha_0 - \beta_1 x_{it-1} \quad \textbf{(6.7)}$$

Fourth step

Substituting **(6.7)** into **(6.5)** we get:

$$u_{it} = \sigma\left(y_{it-1} - \alpha_0 - \beta_1 x_{it-1}\right) + e_{it}$$

$$u_{it} = \sigma y_{it-1} - \sigma\alpha_0 - \sigma\beta_1 x_{it-1} + e_{it} \quad \textbf{(6.8)}$$

Fifth step

Substituting **(6.8)** into **(6.4)** leads to:

$$y_{it} = \alpha_0 + \beta_1 x_{it} + \sigma y_{it-1} - \sigma\alpha_0 - \sigma\beta_1 x_{it-1} + e_{it} \quad \textbf{(6.9)}$$

As Sargan (1964) explains, specification (6.9) is a restricted version of the specification in equations (6.4 and 6.5). The coefficient of x_{it-1} in (6.9) of $\sigma\beta_1$ is equivalent to minus the product of the coefficient on y_{it-1} and x_{it}. Specifically, the negative of the coefficient on the lagged independent variable equals the product of the coefficient on the lagged dependent variable and the coefficient on the current value of the independent variable. This is the common factor restrictions (CFRs). Therefore the autoregressive model defined in equations (6.4 and 6.5) is equivalent to a dynamic linear model if these CFRs restrictions hold, which in essence test whether the dynamics can be modelled in the unobserved part of the model (McGuirk and Spanos, 2009). These restrictions must be tested on each continuous variable jointly and individually. If they hold, the autoregressive model is considered a suitable alternative approach to model a dynamic relationship.

Therefore, to estimate the AR model in this investigation, we must initially test whether the CFRs hold. In this analysis, the common factor restrictions were tested using the FE, and RE estimators. We start from simple static FE and RE estimations and run the Hausman test, the results of which suggest between the FE and the RE

estimators we could use the RE estimator.[13] We then test if the common factor restrictions can be assumed to hold using this estimator. For the model estimated through RE, the common factor restrictions hold for each variable individually and for all of them jointly.[14] Taking into consideration this and the fact that the comparative analysis between the FE and RE through Hausman test suggested that we can use the RE estimator, this analysis is extended further by estimating the (6.10) model by the preferred RE AR (1) estimator.[15] The results are given in Table 6.12.

Table 6.12 Estimation results of RE with AR(1) model[16]

	RE with AR (1) (6.10)	
Variables	Coeff.	P>|t|
Credit_FE (dependent variable)		
Lagcredit_fe	**-**	**-**
Deposit_FE	**0.404*** **	**0.000**
IntRate_diff	**0.008** **	**0.006**
Inf_vol	0.000	0.750
Err_vol	-0.616	0.699
BSRI	0.000	0.996
FO	**0.189** **	**0.037**
FC_lim	**-0.032***	**0.085**
FCop_lim	**0.164*** **	**0.000**
FC_LTV	**0.159*** **	**0.000**
FC_RWA	0.021	0.484
D_2008	0.012	0.623
D_2009	-0.021	0.480
D_2010	-0.018	0.582
D_2011	**-0.075** **	**0.047**
D_2012	**-0.086** **	**0.026**
D_2013	**-0.084** **	**0.034**
_cons	0.066	0.621
rho_ar	**0.570** (estimated autocorrelation coefficient)	
sigma_u	0.052	
sigma_e	0.099	
rho_for	0.217 (fraction of variance due to u_i	
No. of observations	174	
No. of Cross sectional groups	25	

Statistics with *, **, or *** are significant at 10%, 5%, or 1% level, respectively.

[13] The STATA outputs are presented in Appendix 6.7
[14] The STATA outputs are presented in Appendix 6.8
[15] As seen in the results presented in Appendices 6.8, for the model estimated through FE, the null hypothesis that common factor restrictions hold can be rejected.
[16] The STATA outputs are presented in Appendix 6.9.

Given that with the RE AR (1) model we have estimated a model equivalent to the 6.1 model specification estimated through system GMM, in which all the variables are treated as exogeneous, the estimated autocorrelation coefficient rho_ar is comparable to the coefficient of the lagged dependent variable in the model 6.1. In terms of the size the coefficient, the rho_ar (0.570) is a little larger than the equivalent in the 6.1 (0.479), 6.2 (0.524) and 6.3 (0.460) models.

As seen above, in relation to the macroprudential policy instruments the results of the model 6.10 estimated through RE AR (1) are similar to the results of the equivalent model 6.1 estimated through system GMM presented in Table 6.7. In this model, the same three variables of interest are statistically significant. The MP instrument limits on foreign currency loans (FC_lim) here is significant at nine percent whilst in the 6.1 model was significant at seven percent. In both models (6.1 and 6.10) the coefficient of this variable has the expected sign suggesting a negative relationship with the level of credit euroization, and is of a similar size, suggesting a decrease the level of credit euroization by about three percentage points with the imposition of a limit. For the limits on foreign currency positions (FCop_lim), similarly to 6.1, the sign is as expected, but the significance level is higher in the AR(1) model and the estimated size is also a little higher at 16 percentage points (11 percentage points in 6.1 model). The results give higher the significance and size of the estimate of the third instrument caps on LTV ratio (FC_LTV) as well, but the sign, as in 6.1, is not as expected.

The major difference between the RE AR (1) estimates of model 6.10 (given in Table 6.10) and the GMM estimates in Table 6.9 is that many of the conventional determinants of credit euroization are also significant. In model 6.10 three conventional drivers are significant and are of the expected sign. The coefficient of the deposit euroization (Deposit_FE) suggests a 1 p.p. increase in deposit euroization increases credit euroization by 0.4 percentage points. The interest rate differential (IntRate_diff) estimate suggests that an increase of 1 p.p. in the interest rate differential increases the level of credit euroization by 0.8 percentage points. The final conventional driver of credit euroization that is significant is the foreign ownership (FO), where the estimate suggests that a one percentage point increase in foreign ownership increases the level of credit euroization by 19 percentage points.

In addition, in this model (6.10) a few of the time dummies are significant (none where significant in the GMM model estimates). This suggests that there are some un-modelled changes of variables over time that are being captured by these dummies.

To sum up across both the dynamic panel and AR(1) estimations, we have seen above the results of two macroprudential policy instruments, limits on foreign currency loans and limits on foreign currency open positions are quite consistent, in terms of the statistical significance, sign and size of the coefficients, across different model specifications and different estimators. The estimated effects of the caps on LTV ratio and RWA are not as expected. However, this may be because, as argued in section 6.3.2, the complex nature of these instruments means that dummy variables may not be adequate in capturing their effect on the level of credit euroization, whereas the first two macroprudential instruments are much more straightforward. Consequently, a part of the results presented here are not in line with prior expectations and the findings of the previous analysis presented in Chapter 5, needs to be interpreted with caution.

One aspect of this might be that there are hidden differences in terms of the dynamic effects of individual policy instruments, which we are not capturing given that we are assuming the effect of each individual policy instrument has the same lag structure. For example the limits in foreign currency loans (FC_limits) and limits in FC open positions (FCop_lim), tight macroprudential policy instruments which are expected to have an immediate effect, and are found consistently significant and of the right sign in the specifications. Caps on LTV ratios (FC_LTV) and different RWAs (FC_RWA) are less tight and have a more complex pattern and might not have an immediate effect. Consequently, it is not clear whether the insignificance and inconsistency of results with regard to these two macroprudential policy instruments is because of theoretical model misspecification, limitations of the data in terms of the estimation technique or inadequacy in terms of how the dummy variables are modelling the underlying variation of instruments. Another possible reason for the unexpected estimates of the effect of these two variables might be that we are investigating the impact of these policy instruments on the level of credit euroization rather than its growth. This might be particularly problematic for these two variables which are designed to directly affect the growth of the credit euroization rather than its level.

Regarding the conventional drivers of credit euroization, finding some of them insignificant is not necessary surprising given that the existing empirical literature is not very consistent in the signs found, consequently, the insignificance might be a result of opposing effects cancelling out. One other possible explanation for their insignificance in spite of the high explanatory power of the models might be the composition of the model itself, although the model is specified in line with the critical review of the theoretical and empirical literature presented in the second chapter. A possible reason could might be that deposit euroization, besides driving credit euroization, is likely in itself to be driven by the other credit euroization determinants explicitly included in the model. Although, they are not correlated in a simple manner (given that we checked for simple correlation, see Appendix 6.1), they might be correlated in some more complicated fashion which would explain the insignificance of the individual variables but the high explanatory power of the models. To investigate this we estimated the model 6.1 excluding the deposit euroization (Deposit_FE), see Appendix, 6.10. The results give a significant effect of interest rate differential and the degree of significance of the previously significant variables is higher. However, this also increases the significance and the size of the lagged dependent variable suggesting that an additional part of the explanatory power has been included in the history. Additionally to further investigate the issue of complex correlation, we run an auxiliary equation to the 6.1 model specification through OLS, having the deposit euroization (Deposit_FE) on the left hand side and all other independent variables of the 6.1 specification on the right hand side (Appendix 6.11). This is to check the degree of variation of the deposit euroization can be explained through the other independent variables. The adjusted R-squared of this model is 0.56 suggesting our suspicion of a more complex type of correlation between the independent variables is present in our model specification to some extent. This might be a factor in the low significance of the independent variables in an overall statistically powerful model.

6.7 Conclusions

In this chapter we presented the results of the empirical investigation of the impact of macroprudential policy on financial euroization in transition economies. This study represents a first attempt in studying the potential impact of the macroprudential

policy on financial euroization in TEs. In addition, it adds to previous research on the determinants of financial euroization by investigating the use of dynamic panel analysis to adjust for the potential endogeneity not only of the exchange rate volatility but also of the macroprudential policy variables.

Initially the system GMM estimator was employed to investigate the effect of the macroprudential policy on credit euroization. Although the GMM estimator was acceptable in terms of the diagnostic checks, the slightest change of instrumentation gave considerably different coefficient estimates. The results of the three final model specifications were fairly similar in terms of the sign, size, and significance of the coefficients, although we had variables that were estimated with an unexpected sign.

In addition, most of the conventional drivers of credit euroization were not significant across the different specifications. To investigate whether the above mentioned problems were possibly a consequence of the inadequate estimation technique for our data, given the smallness of the sample in terms of cross section groups, we turned to autoregressive models with the dynamics modelled in the error term. The common factor restrictions did hold individually and jointly for the RE AR (1) estimator suggesting that modelling dynamics in the unobserved part of the model, was appropriate. The RE AR (1) estimate has higher significance and size for the macroprudential policy instruments that are significant in the GMM estimates and three conventional drivers of credit euroization are also significant. Arguably, this may show improvement, although this estimation does not take account of possible endogeneity of the explanatory variables.

Finally, we have found some, although limited, evidence that macroprudential policy may be affecting the level of credit euroization in TEs. Two instruments are significant and of the right sign and magnitude of size, across different model specification and estimators, and they are the ones that we thought were most appropriately modelled by dummy variables. However, much more needs to be done on this, because modelling of these policy variables is a difficult task given the complex nature of some of them.

Another possible limitation of the analysis is the estimation technique, which might not enable the correct capturing of some hidden differences in terms of the dynamic effects of the individual policy instruments on the level of credit euroization.

However, this has been just a first look, which suggests that further research into this area may be rewarding. Additional work with better quality data and longer time and cross-section series is needed to corroborate the initial assessment and confirm the causal relationships identified. These caveats notwithstanding, the investigation still provides valuable insights into the impact of macroprudential policy on the level of credit euroization.

Chapter 7

Conclusions

7.1 Introduction

The main aim of the thesis was to empirically investigate the relationships between bank efficiency, euroization and macroprudential policy in TEs while taking into account the impact of different risks associated with euroization. This was achieved through formulating a set of research questions and responding to them using both quantitative and qualitative methods. The investigation of these relationships is of importance to the development of these economies given that the level of euroization in most TEs has remained high over a considerable period, while the degree of financial intermediation in TEs along with their reliance on bank lending as the source of finance have lagged behind advanced economies. In addition, these countries have recently adopted macroprudential policies that in general aim to reduce systemic risk, which might have an impact on the level of euroization.

The rest of the chapter is structured in the following manner. Section 7.2 provides an overview of the main findings of the thesis which are synthesized in relation to the analyses presented in the individual chapters in response to the research questions. The main contributions to knowledge in relation to the key research questions are elaborated in the following section 7.3. The chapter also includes a discussion of the policy implications following from the findings, which is presented in section 7.4. The main limitations of the investigations of the thesis are summarized in section 7.5 and the chapter concludes with section 7.6 where a discussion of the suggested avenues for future research is presented.

7.2 Findings of the thesis

The thesis was focused in undertaking a critical review of the theoretical and empirical literature, developing new empirical framework, and providing new evidence on three distinctive but interrelated dimensions of financial intermediation in TEs, namely the three main pillars of the thesis: euroization, bank efficiency, and macroprudential policy.

Chapter 1 of the thesis highlighted the importance of the concepts of euroization, bank efficiency and macroprudential policy and their relevance in the process of transition to a market based economy. The chapter established that the level of euroization in most TEs has remained high over a considerable period, with the

average degree of euroization varying from 13% in the Slovak Republic to 77% in Albania, throughout the period of 2000 to 2013 (section 1.3). Furthermore, it examined the evolution of the phenomenon of euroization throughout the period and documented that euroization followed different patterns across different countries, making its exploration of interest for policy makers in these countries. Section 1.4 described the development of the banking sector in the first two decades of the transition process establishing that the banking sector in most TEs, has yet to fully develop their role in financial intermediation and facilitating economic growth, highlighting the value in further research into the determinants of banks' efficiency in these countries. As a potential determinant of the level of euroization, the chapter finishes with a discussion of the recently adopted macroprudential policy in many TEs. Thus, Chapter 1 established the importance of empirical exploration of the relationships between euroization, bank efficiency and macroprudential policy.

Having established the importance of the research area in the context of TEs in the first chapter the first key research questions were: **What are the models and empirical evidence on bank efficiency and euroization in the literature? What are the gaps in knowledge in both areas?** In pursuance of these questions, the critical review of the theoretical and empirical literature on euroization and bank efficiency was presented in the Chapters 2 and 3. This enabled a critical evaluation of the models and empirical evidence on euroization and bank efficiency, and the identification of the gaps in the existing literature. These chapters provided a base on which the models used in the empirical chapters were developed in order to explore the identified gaps in the literature. The review of literature on euroization disclosed that whilst euroization has been extensively researched during the last two decades the empirical literature remains limited. First, most of these studies focused solely on deposit euroization, assuming that it mirrored credit euroization. However, as shown in section 1.3, credit euroization is higher than deposit euroization in most TEs; thus, by focusing solely on deposit euroization most studies have underestimated the degree of credit euroization. Second, the review showed that the relationship between euroization and bank efficiency has been completely neglected in the literature. Consequently, the chapter sought to explore the literature on the role of euroization in financial system performance, which although it has increased during the last decade, remains limited and inconclusive. There are only a handful of studies

that explore this relationship and they are restricted in terms of the time span they cover (mostly short and only up to early 2000). In addition, they are conflicting in terms of the impact of euroization on bank efficiency although more studies lean towards a negative impact (section 2.5.3). Finally, the literature is limited in explaining the persistence of euroization in TEs in a stable macroeconomic environment.

The review of the bank efficiency literature indicated that it has mostly focused on advanced economies, the findings of which may not apply to TEs (Weill, 2003). The recent literature on TEs mainly investigates bank efficiency in relation to bank size and ownership; however, to the best of our knowledge it completely ignores euroization, which, as argued in section 1.3, is an important feature of the banking sector in TEs. In addition, the literature has been limited in its exploration of the risk-return aspect associated with banks' operations, in spite of its increasing importance. The few studies that do explore the risk aspect employ a two-step approach that is criticized for biasness (see section 3.4.3), and mostly focus on credit risk, ignoring other types. Finally, the chapter showed, the existing literature is also limited in terms of the time span covered. Most of the studies include a relatively short time span that ends up to mid-2000s; thus, none of the studies employs recent data that cover the period of the global financial crisis (GFC). In terms of cross-sectional coverage most of these studies are focused on the banking sectors in CEE countries, less attention has so far been given to SEE countries.

Chapter 4 covered the first of the empirical investigations of the thesis, concerning the second research question: **What are the determinants of bank efficiency in TEs and in particular how does euroization affect bank efficiency?** A comprehensive stochastic frontier model, which has the advantage of accommodating the multiple input-output production technology of banks, was developed to estimate cost efficiency. The model chosen was time variant to allow efficiency to vary across banks and over time, given the relatively long timescale of our data. Two different time varying efficiency models were employed for the estimation of efficiency: the Battese and Coelli (1995) and Greene TRE (2005), the first is the most frequently used model in the literature whereas the second is used more rarely but is much more flexible. The models are estimated using the one-step approach, which allows for the impact of control variables such as euroization and risks directly in the model,

thus overcoming the serious limitations of the commonly used two-step approach discussed in section 4.3.3. The investigation was conducted using the BankScope database for the period 2000-2013. Two samples were employed which span 14 years from 2000 to 2013, the first one encompassed 1541 banks operating in 20 TEs with data on euroization at country level collected by the author. The second sample encompassed 126 banks operating in seven SEE countries with data on euroization at bank level collected by the author. The relative cost efficiency of banks using the first sample was estimated whilst explicitly including euroization at country level in the frontier and incorporating the risk factors in the inefficiency component. We found evidence that financial euroization at country level affects the cost efficiency of banks in TEs. The results on this are very similar in terms of the sign, size and significance of the coefficients of financial euroization across different model specifications and estimation techniques. They suggest that in countries with a higher degree of financial euroization banks face higher costs, addressing the second key research question presented in section 1.2. As previously highlighted, the bank efficiency literature ignores the impact of euroization in TEs; thus, there is no basis for direct comparison of our results with those in the literature. However, the more general literature, focusing on the impact of euroization on the financial sector, although inconclusive tends more towards a negative impact. The findings of the analysis in Chapter 4 are in line with this.

Having found evidence for the importance of euroization for the cost efficiency of banks at country level, the relationship was also examined for financial euroization at bank level. The relative cost efficiency of banks was estimated whilst explicitly incorporating euroization at bank level and risk factors in the inefficiency component. However, we found no evidence that euroization at bank level affects efficiency. This finding has to be taken with caution given our relatively small sample size. The small sample size in relation to the regressors and the low coverage of the data did not allow the exploration of the impact of all the risk variables and those included were insignificant. In addition, the investigation, in Chapter 4, added to the previous literature in TEs by exploring the risk-return aspect in the context of bank efficiency, an under-researched area. The risk variables, credit risk, operational risk and market risk were introduced in the inefficiency component of the models as they are under a bank's control. These variables were highly significant (with the exception of market risk in the TRE 2005 estimate) and had consistent signs across different estimations.

The finding suggests a positive impact of credit risk, and a negative impact of operational and market risk on cost efficiency. Theoretically, risk variables are expected to have a negative relationship with bank efficiency, thus the opposite sign for one of our risk variables is surprising.

In Chapter 4, particular attention was paid to the impact of the associated risks on the relationship between euroization and bank efficiency. However, their impact could not be fully captured through the initial analysis here, or in other studies, mostly due to their complex nature and the low coverage of the data. Taking into consideration this and the fact that overall there is lack of consistency in the euroization literature in terms of its impact on banking sector performance the research is extended through a qualitative analysis of the phenomenon of euroization at bank level in selected SEE countries. Besides the risk aspect, the qualitative research is used to further explore the relationship between bank efficiency and euroization, addressing the third key research question presented in section 1.2, **What do banks regard as the main determinants of euroization? What are their strategies, policies, and procedures with regard to euroization? Do they feel that euroization affects their efficiency?** In terms of methodology, we used semi-structured face-to-face in-depth interviews and did not supplement this with additional background data on each bank in order not compromise the confidentiality of the participants and banks. Attention to ethical considerations was given throughout different stages of the investigation, from the early design stage through to the findings, to maintain the validity and reliability of the research. Informed consent, use of information and confidentiality were the main issues that were anticipated and planned for when conducting the qualitative research. The semi-structured interviews were conducted by the author in the natural settings of individual banks operating in two SEE countries: Albania and Macedonia. The nature of the research meant that Albania and Macedonia were countries of interest because they have their own currencies and are significantly euroized. However, they differ in terms of their financial systems, exchange rate regimes and economies in general, which may affect perceptions regarding financial euroization and related risks. Thus, it was expected that information obtained would be more richly textured and thus more informative regarding the focus of the study: financial euroization. The analysis based on banks in these two TEs led to a number of conclusions, which may have more general

applicability in other TEs, at least in those with similar banking sectors and a considerable degree of financial euroization.

The findings presented in section 6.6 provide evidence that the governments' macroprudential policy affects the policies and procedures employed by banks in SEE countries and is becoming an important driver of de-euroization. In terms of the other drivers of euroization the findings of this analysis support the conventional view that deposit euroization and the interest rate differential are the main determinants of credit euroization in these countries. With regard to risks, the qualitative analysis revealed that banks seem to be concerned with hedging against the risks associated with FE, see section 5.9, and within our small sample, hedging was typically managed centrally at the group's headquarters. However, with one group of customers, exporters, most of the banks seemed to overly rely on the natural hedging available to this group and seemed to exclude them from their foreign currency lending limits (section 5.8.2). This policy, while giving a low credit risk from this lending, implies that banks are underestimating their own exposures in terms of the risks related to foreign currency. There are also indications that banks are not completely proactive but rather reactive with respect to hedging, with tighter controls being a feature of those which suffered losses in their operations in another country.

Given the finding in Chapter 5 that euroization is affected by macroprudential policy in selected SEE countries, the issue was quantitatively investigated in Chapter 6. The chapter starts with the review of the literature on macroprudential policy and it suggests that the literature on macroprudential instruments is limited, mostly due to scarcity of data as they have become standard policy tools only in recent years. Moreover, the review showed that, to the best of our knowledge, the existing macroprudential literature has ignored the impact of macroprudential dimension on financial euroization. Most of the empirical literature on the macroprudential policy is either focused on investigating its impact on the overall accelerated credit growth or specifically on the growth of housing sector credit. This thesis extends this literature by investigating how this policy may affect the levels of financial euroization in TEs. This section of the chapter therefore responds to the first key research question presented in section 1.2. The empirical investigation that follows is for 25 TEs over the 2007-2013 period, using data on macroprudential policies collated by the author.

The investigation used panel techniques incorporating a dynamic element. To account for the dynamics of the relationship initially a GMM estimator was employed. Advantages of this estimator are: instrumenting from previous levels and differences from within the sample is possible for the variables that are not strictly exogenous; it does do not require distributional assumptions; and can allow for heteroscedasticity of unknown form (Verbeek, 2000, pp. 143 and 331; Greene, 2002, pp.201, 525 and 523). However, the findings suggested that the slightest change in instrumentation changed the estimated results considerably and we suspected this was because of the width of our panel, as these methods were devised for wide and short panels. Thus, we also estimated the relationship using an autoregressive (AR1) model, which enables the modelling of dynamics in the error term. The results provided some limited evidence that macroprudential policy may affect the level of credit euroization in TEs. Two macroprudential policy instruments, limits on foreign currency loans and limits on foreign currency open positions, were significant and had the correct sign and magnitude across different model specifications and estimators. The results support the findings of the qualitative analysis presented in Chapter 5 given that in both analyses the impact of the same policy instrument was explored. The results for the other two instruments investigated were not as expected, but this could be because our model does not capture the more complex nature of these instruments (section 6.3.2). Thus, Chapter 6 addressed the last key research question presented in section 1.2, **Does macroprudential policy have an impact on the level of credit euroization in TEs?**

The main findings of the thesis provide some timely, informative, and enlightening insights into the three pillars the thesis. The findings of the individual analyses presented in Chapters 4, 5 and 6, presented above, are consistent with each other. In general, the thesis suggests that euroization has negatively affected the cost efficiency of banks operating in TEs during the last decade. In addition, the findings suggest that the euroization phenomenon in TEs is persistent despite a stable monetary policy, but specific government policies targeting euroization, such as macroprudential policy, may have some success in reducing it.

7.3 Contributions to knowledge

In relation to the three main pillars of this thesis: bank efficiency, euroization, and macroprudential policy, the models and empirical evidence in the respective literatures were investigated to identify the existing gaps, which were explored in empirical Chapters 4, 5 and 6, and resulted in the following contributions to knowledge.

This study contributes to the bank efficiency literature with respect to TEs by being, to the best of our knowledge, the first study that comprehensively analyses bank efficiency whilst considering the effect of euroization. The thesis explores the impact of euroization at both country and bank level on bank efficiency, finding evidence supporting a negative impact at the first level. An additional contribution of the thesis is the exploration of the impact of risks on bank efficiency, given that the previous literature has neglected the impact of risks (other than credit risk). The thesis addresses this gap and confirms the negative impact of market and operational risk on bank efficiency, further extending the bank efficiency literature. Furthtermore, by covering an extended period (14 years) the study considers more years than has previously been studied which is important in terms of capturing the impact of the continuing presence of euroization in TEs and the time variation of banks' efficiency. The findings suggested that efficiency has varied throughout the period under consideration.

The thesis contributes to the existing literature on euroization in several ways. First, the thesis contributes to knowledge by being the first qualitative research of the euroization phenomenon through the banks' lenses. Specifically the analysis investigates: the main determinants of euroization according to the banks; and banks' strategies, policies, and procedures with regard to euroization. Again, to the best of our knowledge, such an investigation has not been conducted before in this context. Given the lack of such literature on financial euroization, this study breaks new ground and contributes to a better understanding of the euroization phenomenon. The study also contributes by identifying macroprudential policy as a determinant of euroization. Another conceptual framework related to financial euroization identified by this study, which could be further examined in the future, is the effect of banks' lending policy towards exporters on the outcomes of banks' hedging strategies.

Second, although the euroization literature is extensive, the existing empirical literature remains limited given that most of these studies focus solely on deposit euroization, assuming that credit euroization mirrors this. However, credit euroization is higher than deposit euroization in most TEs; thus, by focusing solely on deposit euroization most studies have underestimated the degree of credit euroization. Accordingly, this study extends the existing literature by investigating euroization focusing on credit euroization.

Third, the thesis contributes to knowledge also by extending the quantitative empirical literature on determinants of euroization and addressing the relationship between euroization and macroprudential policy. This is the first study to consider the impact of macroprudential policy in addition to the effect of the conventional drivers of euroization. The findings confirm the theory and the research in Chapter 5, by providing evidence that macroprudential policy negatively affects the level of credit euroization in TEs. In addition, the thesis adds to previous research on the determinants of financial euroization by investigating the use of dynamic panel analysis to differentiate between the shortrun and longrun effects of the determinants of euroization and to adjust for the potential endogeneity not only of the exchange rate volatility but also of the macroprudential policy variables. In the existing literature, only one study (Vieira et al., 2011) employs dynamic panel analysis to investigate the determinants of financial euroization. However, they focus on deposit euroization and cover the period before the global financial crisis using data up to 2006.

In terms of the contribution to methods of investigation, the thesis showed that:

- Future qualitative investigations could result in useful insights if they are carefully designed, even though the confidential nature of the data makes this type of investigation difficult;
- In addition, the thesis supports Greene's view that not taking account of unobserved heterogeneity between banks in efficiency studies could have led to higher estimated levels of inefficiency.

7.4 Policy implications

The thesis has addressed the relationships between bank efficiency, euroization and macroprudential policy in TEs. The findings have shed important lights on policy implications for governments and banks and led to the following policy recommendations in TEs.

The main findings of the thesis suggested that euroization is an important feature of the banking sector in TEs. First, the thesis showed that the degree of euroization has remained high during the last 14 years in most of the TEs. It also documented the continuous presence of currency mismatches in the banking sector of TEs throughout this period, something which was ignored by the early empirical literature on euroization. As discussed in sections 1.3, 2.2.2 and 2.3 the literature on euroization, particularly the early studies, maintained that currency mismatches in banks' balance sheets was not an issue because they believed that euroization in assets and liabilities sides should mirror each other mostly due to regulatory requirements. Furthermore, given this and also the lack of readily available data, the previous authors focused only the liabilities side of banks' balance sheets and generalized the findings. However, in addition to documenting the continuous presence of currency mismatches in the banking sector of TEs throughout this period, this thesis also showed that these sectors were more euroized in their assets side, thus suggesting that the existing literature that ignored this side and studied the liabilities side in isolation may have underestimated the degree of euroization in these countries. The continuous high degree of euroization and the presence of currency mismatches is of particular interest to policymakers in TEs given that the estimates in section 4.6.1 suggested that banks operating in countries with a higher degree of euroization faced higher costs. Thus, if the level of euroization has a negative impact on the cost efficiency of banks operating in TEs, policymakers in these countires should be concerned with the issue of euroization given that this may be one of the reasons why banking sectors in their countries are still lagging behind advanced economies in terms of financial intermediation. The finding of the thesis may also be of interest to the governments in TEs given the importance of efficient financial intermediation from the perspective of economic growth in these countries, where the banking sector dominates the financial system. Taking this into consideration, and given that, as discussed in detail previously in section 2.4.2, euroization also weakens the

monetary transmission mechanisms and reduces the power of central banks over their monetary policy, the thesis suggests that these countries should be concerned with reducing the degree of financial euroization in their banking sectors.

Second, regarding the risks associated with euroization and bank efficiency in TEs the thesis provided support for the view that banks operating in TEs are concerned with risks related to euroization and with hedging against these risks (section 5.9). However, they seem to rely mainly on natural hedging and ignore naturally hedged clients (exporters) in terms of their limits to foreign currency exposures- thus, they are underestimating their own exposure to foreign currency risks. This could also be the reason behind the continuous presence of currency mismatches in banks' balance sheets documented in the thesis (section 1.3), which could prove problematic in times of crisis. In addition, the evidence provided in section 5.9 suggested that banks are being reactive with regard to foreign currency risk management rather than proactive, taking into consideration that those that had the strictest strategy with regards to hedging were the ones that had losses due to foreign currency risk materializing in their operations in another country. This may be of interest to both bankers and regulators because it can mean that the current risk management approaches might only seem reasonable because the risks related to foreign currency have not materialized, given the low exchange rate volatility and the fixed exchange rate regimes pursued in many TEs. Thus, a more active hedging policy may be preferable.

Third, the thesis provided evidence that euroization is very entrenched in TEs given that it has remained high during the last 14 years as initially discussed in section 1.3 of the thesis which is later supported also by the estimates presented in section 6.6, providing evidence of a strong lagged effect. The descripitive sections 1.3 and 1.4 together with the empirical evidence provided in section 6.6 suggest that reducing inflation to moderate levels and applying other responsible macroeconomic policies is not enough to reduce high levels of eurozation, once established. Thus, the thesis strongly suggests that governments need a specific active policy if they wish to reduce euroization.

Fourth, the thesis provided evidence that macroprudential policy has a negative impact on the level of euroization (section 6.3.2). Considering that the thesis has

found a negative relationship between euroization and cost efficiency of banking sectors in TEs, the thesis supports the view that macroprudential policy is an appropriate strategy to reduce the levels of financial euroization in TEs. Although it is a first examination of this relationship, both the qualitative analysis in chapter 5 and the quantitative empirical investigation in chapter 6 provide evidence of the negative impact of these policies, particularly of the instruments directly linked with euroization, on the level of euroization. Thus the recommendation is that the governments in these countries should continue to pursue these policies, specifically these instruments, given that the same were explored in both analyses or consider adopting them if they have not already done so. Moreover, if the immediate reduction of euroization is the forefront of government policies, they should consider adopting a specific de-euroizing strategy given that the findings of the qualitative analysis presented in section 5.9 suggest this to be a very successful strategy.

In addition, given the findings in this thesis, by reducing the level of euroization through the adoption of specific macroprudential policy instruments, TEs are likely to improve the cost of efficiency of their banking sectors, as well as having certain macroeconomic effects such as recovering some degree of their lost power over monetary policy. Of course, the impact of the macroprudential policy should be assessed and monitored carefully, taking into consideration that this could be a shock to the banking sector and it could in the short run lead to greater inefficiency in the banking sectors. Thus governments in these countries should carefully analyse and compare the benefits of the reduction of the degree of euroization and increased cost efficiency in the long run with possible higher inefficiency in the short run. Moreover, given the extended recent attention that macroprudential policy is receiving and the latest European discussion on standardising it, TEs might be obliged to employ them as such thus, they ought to invest more in understanding their impact. Particulary, given that as previously discussed in section 6.2. macroprudential policy instruments have been adopted only very recently and their implications for the economy as a whole are still not fully understood and possible side effects are not fully clear at this stage, thus governments need to continually monitor their effects carefully.

Finally, the thesis showed that the banking sector performance in TEs was affected by the global financial crisis through their reduced cost efficiency during the crisis years, but they also seem to have recovered rapidly. However, the thesis is limited in

pinpointing the specific factors that led to the effect of the crisis on cost efficiency or the factors that contributed to the rapid recovery. Nevertheless, the evidence provided suggests that concerns about external exposure do not have to be the forefront of these governments' policies.

7.5 Limitations of the thesis

As with most empirical investigations, this thesis has faced a number of limitations. The first issue of concern was the quality of the data. As discussed in section, 4.4 although the BankScope database has many advantages, particularly providing researchers with comparable analyses across banks in different countries, it requires extensive cleaning. The process of data cleaning has been described in detail in Appendix 4.1 and, given the large degree of missing observations, attention should be drawn to the data quality when discussing the findings results should be treated with some caution. A more important limitation of the data was the fact that BankScope did not have the data on credit euroization and this had to be obtained by searching individual banks' reports and websites. As a result, the number of bank for which the full data was available was much smaller than that of the main empirical work. The results therefore had to be interpreted with even greater caution.

Another limitation in terms of methodology was that with frontier analysis the rankings of banks by their measured cost efficiency can differ, although the central tendency of average cost-efficiency values for banks is generally similar across frontier techniques (Berger and Humphrey, 1997). To overcome this, studies usually compare efficiency estimates from different techniques. This thesis initially considered to estimate efficiency through both DEA and SFA to enable comparability, however after a careful consideration the DEA was not pursued given that SFA is considered more appropriate when the focus of interest is in the impact of the environment, in this case the impact of the euroization on bank efficiency, rather than the rankings of the efficiency estimates.

Another methodological issue with efficiency estimates obtained through frontier techniques is that they are only a relative measure of efficiency against the most efficient bank within the sample. Thus, if the most efficient bank within the sample it

is not fully efficient, the measurement of the efficiency would be inaccurate. Although as mentioned above, the focus of the thesis was not on the ranking of the efficiency estimates, to address this issue the quantile techniques suggested by Koenker (2004) were considered. However, the quantile panel techniques are not technically mature and there are fundamental difficulties in interpreting the parameters and ensuring that the dynamics are accounted for; thus the method was not pursued.

In terms of the qualitative analysis, presented in Chapter 5, concerns about confidentiality affected the research design and methodology from the start. We used only semi-structured face-to-face in-depth interviews and did not supplement the interview results with data from other published sources, in order to retain the confidentiality of participants and banks and not to identify them. With a larger sample size, these concerns may be lessened, at least in economies with a large number of banks, although this would be very time consuming. In addition, although the apparent openness with which the interviewees shared their perspectives is one of the strengths of this study, the inability to validate the data through respondent checks (and use of data from various databases) is one of the main limitations. However, as explained in section 6.6, substantial internal consistency in views and themes across interviewees was observed. Another issue, with this analysis is that the investigation is limited to the experiences of particular banks; thus, the generalizability of the findings are not clear. Nevertheless, the combined implications of their experiences should shed light on how banks view and address the FE phenomenon in SEE, therefore thematic generalizability (Creswell, 2007) is certainly a possibility.

In the analysis of macroprudential policy, the limitations are mainly related to data. Initially, given that we are exploring the impact of macroprudential policy on the level of credit euroization through dynamic panel techniques we have a rather narrow panel, we meet the minimum criteria for the investigation but the panel was not wide enough to ensure the stable modelling of the dynamics through system GMM. Therefore, we explored an additional method of modelling dynamics: the autoregressive regressions. A main limitation remains the specifications of the macroprudential policy instruments variables, which were in the form of dummy variables. However, for two of the policies this was perceived as problematic given

their complex nature and the empirical results for these two polices were not as expected. This might be due to the limitations of the estimation technique that might not enable the correct capturing of some hidden differences in terms of the dynamic effects of the individual policy instruments on the level of credit euroization.

7.6 Avenues for future research

The findings of the thesis suggest several avenues for future research. The thesis initially has contributed to knowledge by estimating bank efficiency through SFA in TEs, whilst controlling for euroization initially at country level then at bank level. The findings of this analysis suggested the importance of the euroization dimension in financial intermediation in TEs. A similar approach could be used to test the same hypothesis in a different sample of countries, such as those of Latin America where 'dollarization' is very common. A comparison between the two samples would be an interesting validation strategy of this finding. Other possible extensions of the research could be estimation of bank efficiency by choosing a different set of inputs-outputs and accounting for the impact of deposit euroization on bank efficiency, or a fuller investigation of the effect of credit euroization at bank level if more data on bank level euroization became available.

The second main contribution to knowledge was the qualitative investigation of the euroization phenomenon. For practical reasons the investigation was limited to two selected countries in which the author could conduct the interviews. This investigation could be extended by conducting a qualitative analysis of euroization in a larger sample of banks and countries. A wider comparison would be interesting because it would enable the comparison of the findings of this investigation. In addition, the lack of previous similar studies meant that this analysis was very wide in terms of themes, and subthemes. Therefore, this first attempt could be extended by more detailed qualitative investigations into specific themes providing a deeper investigation of different dimensions of euroization. This could shed more light on the factors that influence euroization and the impact of euroization on bank performance according to the supply side, i.e. banks.

The third main contribution to the knowledge was the empirical investigation of the macroprudential policy on the level of credit euroization. Whilst the findings support

the qualitative analysis in finding that this policy has a negative impact on the level of credit euroization, we have been cautious in recommending specific policy actions. This investigation could be extended by conducting a similar investigation in different settings, for instance with the highly dollarized economies in Latin America, or further exploration of the macroprudential instruments that may impact euroization.

Finally, the thesis provided evidence that the banking sectors in TEs have suffered in terms of their cost efficiency during the global financial crisis but also have very rapidly recovered. Another area for future research is an empirical exploration of the specific factors that have contributed to the rapid recovery from the consequences of the global financial crisis given that the thesis only indicates the overall effect.

References

Ahn, S.C., Good, D.H., and Sickles, R.C., (2000) Estimation of Long-Run Inefficiency levels: *A Dynamic Frontier Approach. Econometric Reviews, Vol. 19, No. 4, 461-492*.

Ahuja, A. and Nabar, N., (2011) Safeguarding Banks and Containing Property Booms: Cross-Country Evidence on Macroprudential Policies and Lessons from Hong Kong SAR. *International Monetary Fund (IMF) Working Paper, No. 284.*

Aigner, D.J., and Chu, S.F., (1968) On estimating the industry production function. *American Economic Review, Vol, 58, pp. 826-839.*

Aigner, D.J., Lovell, C.A.K., and Schmidt, P., (1977) Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of Econometrics, Vol. 6, pp. 21-37.*

Alesina, A., and Barro, R., (2002) *Currency Unions. Quarterly Journal of Economics, Vol. 117, No.2, pp. 409-436.*

Altunbas, Y., Carbo, S., Gardener, E.P.M., and Molyneux, P., (2007) Examining the relationships between capital, risk and efficiency in European banking. *European Financial Management, Vol. 13, pp. 49-70.*

Altunbas, Y., Gardener, E.P.M., Molyneux, P., and Moore, P., (2001) Efficiency in European banking. *European Economic Review, Vol. 45, pp. 1931-1955.*

Altunbas, Y., Liu, M., Molyneux, P., and Seth, R., (2000) Efficiency and risk in Japanese banking. *Journal of Banking & Finance, Vol. 24, pp. 1605-1628.*

Altunbas, Y., and Molyneux, P., (1994) "Sensitivity of Stochastic Frontier Estimation to Distributional Assumptions: the Case of the German Banks", *Institute of European Finance Publication/Bangor, Discussion paper.*

Altunbas, Y., Marqués-Ibáñez, D., and Manganelli, S., (2011) Bank risk during the financial crisis: do business models matter? *European Central Bank Working Paper, Series No. 1394.*

Alvares-Plata, P., and Garcia Herrera, A., (2007) To Dollarize or to De-dollarize: Consequences for Monetary Policy*. Bank for International Settlements Publication and Research. Accessed at: http://www.bis.org/author/patricia_alvarez-plata.htm*

Amsler, C., Lee, Y.H., and Schmidt, P., (2009) A survey of stochastic frontier models and likely future developments. *Seoul Journal of Economics, Vol. 22, No.1, pp. 5-27.*

Anderson, R., and Kegels, C., (1998) *Transition banking: Financial development of central and eastern Europe.* Oxford, Clarendon Press Oxford.

Arellano, M. & Bond, S., (1991) Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies, Vol. 58, No. 2, pp. 277-97.*

***A*rellano, M.,** (2003) *Panel Data Econometrics*, Oxford University Press, Oxford.

Arellano, M., and Bond, S., (1991) Some tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies, vol. 58, pp. 277-297.*

Arellano, M., and Bover, O., (1991) Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics, Vol. 68, pp. 29-51.*

Arteta, C., (2003) Are financially dollarized countries more prone to costly crises? Board of Governors of the Federal Reserve System*. International Finance Discussion Paper, No. 763.*

Arteta, C., (2005) Exchange rate regimes and financial dollarization: Does flexibility reduce currency mismatches in bank intermediation? *Board of Governors of the Federal Reserve System International Finance Discussion Papers, No. 738.*

Avkiran, N., (2006) Developing foreign bank efficiency models for DEA grounded finance theory. *Socio-Economic Planning Sciences, Vol. 40, No.4, pp. 275-296.*

Baker, A., (2012) The New Political Economy of the Macroprudential Ideational Shift. *New Political Economy, Vol. 18, No.1, pp. 112-139*

Baliño, T., Bennett, A., and Borensztein, E., (1999) Monetary Policy in Dollarized Economies. *International Monetary Fund Occasional Paper, No. 171.*

Baltagi, B., (1985) Pooling Cross-Sections with Unequal Time-Series Lengths. *Economics Letters, Vol. 18, pp. 133-136.*

Baltagi, B., (2001, 2nd Ed.) (2005, 3rd Ed.) Econometric Analysis of Panel Data. *John Wiley, Chichester, England, New York, NY.*

Banda, H.S., and Verdugo, E.B., (2008) Translog Cost Functions: An Application for Mexican Manufacturing. *Banco de México Working Papers.*

Bank of Albania, (various years) Annual Reports and Monetary Surveys www.bankofalbania.org.

Bank of Latvia, (various years) Annual Reports and Monetary Surveys www.bank.lv.

Bank of Slovenia, (various years) Annual Reports and Monetary Surveys www.bsi.si.

Barajas, A., and Morales, A., (2003) Dollarization of Liabilities: Beyond the Usual Suspects. *International Monetary Working Paper, No.11.*

Basso, H., Calvo-Gonzales, O., and Jurgilas, M., (2011) Financial Dollarization. The Role of Banks and Interest Rates. *Journal of Banking and Finance, Vol. 35, pp. 794-806.*

Battese, G., and Coelli, T., (1992) Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India. *Journal of Productivity Analysis, Vol. 3, No. 1, pp. 153-169.*

Battese, G.E., and Coelli, T.J., (1995) A Model of Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. *Empirical Economics, Vol. 20, pp. 325-332.*

Bauer P., Berger, A., and Humphrey D., (1993) Efficiency and Productivity Growth in U.S. Banking, *in The Measurement of Productive Efficiency: Techniques and Applications. (Editors: H. Fried, C.A.K. Lovell, P. Schmidt),* Oxford University Press, 386--413.

Bauer, P., Berger, A., Ferrier, G., and Humphrey, D., (1998) Consistency Conditions for Regulatory Analysis of Financial Institutions: A comparison of Frontier Efficiency Methods. *Journal of Economics and Business, Vol. 50, No.2, pp. 85-114.*

Bauer, P.W., and Hancock, D., (1993) The Efficiency of the Federal Reserve in Providing Check Processing Services*. Journal of Banking and Finance, Vol. 17, No. 2, pp. 287-311.*

Baxter, J., and Eyles, J., (1997) Evaluating Qualitative Research in Social Geography: Establishing 'Rigour' in Interview Analysis. *Transactions of the Institute of British Geographers, Vol. 22, No. 4, pp. 505–525.*

Beck, T., Demirguc-Kunt, A., and Levine, R., (2001) Law, Politics and Finance. *World Bank Policy Research Working Paper, No. 2585.*

Belotti, F., and Ilardi, G., (2012) Consistent Estimation of the "True" Fixed-effects Stochastic Frontier Model. *Tor Vergata University CEIS Research Paper, No. 231*.

Belotti, F., Daidone, S., Ilardi, G., and Atella, V., (2012) Stochastic Frontier Analysis Using Stata. *University of Rome II - Centre for International Studies on Economic Growth (CEIS) Working Paper, No. 251.*

Bencivenga, V., and Smith, B.D., (1991) Financial Intermediation and Endogenous *Growth. The Review of Economic Studies, Vol. 58, No. 2, pp. 195-209.*

Benigno, G., Otrok, C., Rebucci, A., Young, E., (2011) Financial Crisis and Macro-Prudential Policies. IDB Working Paper Series, No*. Inter-American Development Bank, IDB No. 238.*

Berg, A., and Borensztein, E., (2000) The Pros and Cons of Full Dollarization. *International Monetary Fund Working Paper, No. 50.*

Berger, A. N., and Mester, L. J., (2003) "Explaining the dramatic changes in performance of US banks: technological change, deregulation, and dynamic changes in competition," *Journal of Financial Intermediation, Elsevier, Vol. 12, No. 1, pp. 57-95.*

Berger, A., and DeYoung, R., (1997) Problem loans and cost efficiency in commercial banks*. Journal of Banking and Finance*, *Vol. 21, pp. 849–870.*

Berger, A., and Humphrey, D., (1991) The dominance of inefficiencies over scale and product mix economies in banking. *Journal of Monetary Economics, Vol. 28, No.1, pp. 117 - 148.*

Berger, A., and Humphrey, D., (1992) Measurement and efficiency issues in commercial banking. Griliches, Z. (Ed.), Measurement Issues in Service Sectors. *National Bureau of Economic Research, Chicago Press, University of Chicago, IL.*

Berger, A., and Humphrey, D., (1997) Efficiency of Financial Institutions: International Survey and Directions for Future Research. *European Journal of Operational Research, Vol. 98 pp. 175-212.*

Berger, A., and Mester, L., (1997) Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions? *Journal of Banking and Finance, Vol. 21, pp. 895-947.*

Berger, A., Hunter, W., and Timme, S., (1993) The Efficiency of Financial Institutions: A Review and Preview of Research Past, Present, and Future, *Journal of Banking and Finance, Vol. 17, pp. 221-249.*

Berger, A., Hunter, W.C., and Timme, S.G., (1993) The efficiency of financial institutions: a review and preview of research past, present, and future. *Journal of Banking and Finance, Vol. 17, pp. 223-227.*

Berglof, E. and Bolton, P., (2002) The Great ivied and Beyond: Financial Architecture in Transition. *Journal of Economic Perspectives, Vol. 16, No. 1, pp. 77-100.*

Berkmen, S.P., and Cavallo, E., (2010) Exchange rate policy and liability dollarization: What do the data reveal about causality? *Review of International Economics, Vol. 18, No. 5, pp. 781-795.*

Bogdan, R., and Biklen, S.K., (1992) *Qualitative research for education: An introduction to theory and methods.* Allyn & Bacon, Boston,.

Bogdan, R.C., and Biklen, S.K., (2007) *Qualitative research for education: An introduction to theories and methods (5th ed.).* Pearson Education, Boston.

Bond, S., (2002) Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice. *The Institute for Fiscal Studies, Working Paper No. O9.*

Bond, S., (2002a) Dynamic Panel Models: A Guide to Micro Data Methods and Practice. *Institute for Fiscal Studies / Department of Economics, UCL, CEMMAP (Centre for Microdata Methods and practice) Working Paper, CWPO9/02.*

Bonin, J., (2001) Financial Intermediation in Southeast Europe: Banking on the Balkans, *The wiiw Balkan Observatory, Working Papers, No. 006.*

Bonin, J., (2004) Banking in the Balkans: The Structure of Banking Sectors in Southeast Europe. *Economic Systems, Vol. 28, No. 2, pp. 141–153.*

Bonin, J., and Wachtel, P., (2003) Financial Sector Development in Transition Economies: Lessons from the First Decade. *Financial Markets, Institutions and Instruments, Vol. 12, pp. 1-43.*

Bonin, J., Hasan, I., and Wachtel, P., (2005) Bank performance, efficiency and ownership in a transition countries. *Journal of Banking and Finance*, *Vol. 29, pp. 31–53.*

Borio, C., and Crockett, A., (2000) In search of anchors for financial and monetary stability. *Greek Economic Review, Vol. 20, No. 2, pp. 1-14.*

Borovicka, J., (2007) Banking Efficiency and Foreign Ownership in Transition: ls there Evidence of a Cream-Skimming Effect? *Oesterreichische Nationalbank Financial Stability Report, No. 13, pp. 68-82.*

Bravo-Ureta, B., and Ahmad, M., (1996) Technical Efficiency Measures for Dairy Farms Using Panel Data: *A Comparison of Alternative Model Specifications, JPA, Vol. 7, No. 4, pp. 399-415.*

Brissimis, S.N., Delis, M.D., and Papanikolaou, N.I., (2008) Exploring the nexus between banking sector reform and performance: evidence from newly acceded EU countries. *Journal of Banking and Finance, Vol. 32, No. 12, pp. 2674-2683.*

Broda, C., and Levy Yeyati, E., (2006) Endogenous Deposit Dollarization. *Journal of Credit, Money and Banking, Vol. 38, No.4, pp. 963-988.*

Brown, M., and De Haas, R., (2012) Foreign banks and foreign currency lending in emerging Europe. *Economic Policy, CEPR; CES; MSH, Vol. 27, No. 69, pp. 57-98.*

Brown, M., and Stix, H., (2014) The euroization of bank deposits in Eastern Europe. *Economic Policy, Vol. 30, No. 81, pp. 95-139.*

Brown, M., Ongena, S., and Yesin, P., (2011) Foreign currency borrowing by small firms in the transition economies. *Journal of Financial Intermediation, Vol. 20, pp. 285–302.*

Brunnermeier, M. K., Crocket, A., Goodhart C., Persaud Avi and Shin Hyun, (2009), Fundamental Principles of Financial Regulation, *11th Geneva Report on the World Economy.*

Bryant, J., (1980) A model of Reserves, Bank Runs, and Deposit Insurance. *Journal of Banking and Finance, Vol. 4, p. 335-344.*

Bryman, A., (2006) Integrating quantitative and qualitative research: how is it done? *Qualitative research, Vol. 6, No. 1, pp. 97 – 113.*

Brzoza-Brzezina, M., and Chmielewski, T., and Niedzwiedzinska, J., (2010) Substitution between domestic and foreign currency loans in Central Europe. Do central banks matter? *European Central Bank Working Paper, 1187.*

Bulgarian National Bank, (various years) Annual Reports and Monetary Surveys www.bnb.bg.

Calvo and Reinhart, (2002) Fear of floating. *Quarterly Journal of Economics, Vol. 117, No. 2, pp. 379-40.*

Calvo, G., (2001) Capital Markets and the Exchange Rate: with Special Reference to the Dollarization Debate in Latin America. *Journal of Money, Credit, and Banking Vol. 33, No. 2, pp. 312-334.*

Calvo, G., (2002) On Dollarization. *Economics of Transition, Vol. 10, No. 2, pp. 3939-403.*

Calvo, G., and Guidotti, P., (1990) Credibility and Nominal Debt. Exploring the Role of Maturity in Managing Inflation. *International Monetary Fund Staff Papers, Vol. 47, No. 3.*

Calvo, G., and Veigh, C., (1992) Currency Substitution in Developing Countries – An Introduction. *International Monetary Fund, Working Papers, No. 40.*

Caruana, J., (2010) *Macroprudential policy: working towards a new consensus*. Remarks at the high-level meeting on "The Emerging Framework for Financial Regulation and Monetary Policy" jointly organised by the BIS's Financial Stability Institute and the IMF Institute, Washington DC, 23 April.

Casu, B. and Molyneux, P., (2003) A comparative study of efficiency in European banking. *Applied Economics, Vol. 35, No.17, pp. 1865-1876.*

Casu, B., and Giradone, C., (2006) Bank competition, concentration and efficiency in the single European market. *The Manchester School, Vol. 74, No.4, pp. 441-468.*

Catao, L., and Terrones, M., (2000) Determinants of Dollarization: The banking Side. *International Monetary Fund Working Paper, No.146.*

Caudill, S.B., and Ford, J.M., (1993) Biases in frontier estimation due to heteroscedasticity. *Economics Letters, Vol. 41, No. 1, pp. 17–20.*

Caudill, S.B., Ford, J.M., and Gropper, D.M., (1995) Frontier estimation and firm-specific inefficiency measures in the presence of heteroscedasticity. *Journal of Business & Economic Statistics, Vol. 13, No. 1, pp. 105–111.*

Caviglia, G., Krause, G., and Thimann, C., (2002) Key features of the financial sectors in EU accession countries. *European Central Bank Financial Sectors in EU Accession Countries No.15 -3.*

Central Bank of Armenia, (various years) Annual Reports and Monetary Surveys www.cba.am.

Central Bank of Bosnia and Herzegovina, (various years) Annual Reports and Monetary Surveys www.cbbh.ba.

Central Bank of Russia, (various years) Annual Reports and Monetary Surveys www.cbr.ru.

Central Bank Of the Republic of Azerbaijan (various years) Annual Reports and Monetary Surveys www.cbar.az.

Central Bank of the Republic of Kosovo, (various years) Annual Reports and Monetary Surveys: www.bqk-kos.org.

Central Bank of the Republicof Lithuania, (various years) Annual Reports and Monetary Surveys www.lb.lt.

Chang, R., and Velasco, A., (2003) Dollarization: Analytical Issues. In Levy Yeyati, E., and Sturzenegger, F., (2001) Dollarization: A Primer. *Cambridge and London: MIT Press: 1-5.*

Charnes, A., Cooper, W., and Rhodes, E., (1978) Measuring Efficiency of Decision Making Units. *European Journal of Operations Research, Vol.6, pp. 429-444.*

Chelo, M., and Manlagnit, V., (2011) Cost efficiency, determinants, and risk preferences in banking: A case of stochastic frontier analysis in the Philippines, *Journal of Asian Economics, Vol. 22, pp. 23-35.*

Chiu, Y., and Chen, Y., (2009) The analysis of Taiwanese bank efficiency: Incorporating both external environment risk and internal risk. *Economic Modelling, Vol. 26 pp. 456-463.*

Claessens, S., Demirgüç-Kunt, A., and Huizinga, H., (2001) How does Foreign Entry Affect Domestic Banking Markets?, *Journal of Banking and Finance, Vol. 25: 891-991.*

Claessens, S., Pozsar, Z., Ratnovski, L., and Singh, M., (2012) Shadow Banking: Economics and Policy. *International Monetary Fund, IMF Staff Discussion Note, No. 12.*

Classenss, S., Ghosh, S.R., Mihet, R., (2014) Macro-Prudential Policies to Mitigate Financial System Vulenrabilities. *International Monetary Fund Working Paper, No.155.*

Click, R., (2007) The Latin American Dollar Standard in the post-crises era. *George Washington University. Accessed at Social Science Research Network, (SSRN); http://www.ssrn.com.*

Cochrane, D. and Orcutt, G. (1949), Application of Least Squares Regression to Relationships Containing Autocorrelated Error Terms. *Journal of the American Statistical Association, Vol. 44, pp. 32–61.*

Coelli, T., Prasada, D., and Battese, G., (1998) *An Introduction to Efficiency and Productivity Analysis*. Kluwer Academic Publishers.

Coelli, T., Rao, D., and Battese, G., (2005) *An introduction to efficiency and productivity analysis (2nd ed.).* Springer Science Business Media, New York *New York*.

Coelli, T.J., (1995) Recent developments in frontier modelling and efficiency measurement. *Australian Journal of Agricultural Economics, Vol. 39, No. 3, pp. 219-245.*

Cohen, B., and Gujarati, D., (1970) The Student's t Test in Multiple Regression under Simple Collinearity. *Journal of Financial and Quantitative Analysis, Vol. 5, No. 03, pp. 341-351*

Cohen, B.J., (2004) *The Future of Money.* Princeton University Press, New Jersey.

Cook, D., (2004) Monetary Policy in Emerging Markets: Can Liability Dollarization Explain Contractionary Devaluations? *Journal of Monetary Economics, Vol. 51, No. 6, pp. 1155-1181.*

Cornwell, C., Schmidt, P., and Sickles, R., (1990) Production Frontier with Cross-Sectional and Time-Series Variation in Efficiency Levels. *Journal of Econometrics, Vol. 46, pp. 185-200.*

Court, E., Ozsoz, E., and Rengifo, E., (2010) Deposit Dollarization and Its Impact on Financial Deepening in the Developing World. *Fordham University Department of economics Discussion Paper, Series No. 8.*

Creswell, J.W., (2007) Qualitative inquiry and research design: Choosing among five approaches. *SAGE Publications Inc, Thousand Oaks, CA.*

Creswell, J.W., (2012) *Educational research: Planning, conducting, and evaluating quantitative and qualitative research (3rd ed.).* SAGE Publications Inc, Los Angeles, CA .

Croatian National Bank, (various years) Annual Reports and Monetary Surveys www.hnb.hr.

Crowe, C., Dell'Ariccia, G., Igan, D., and Rabanal. P., (2011) Policies for Macrofinancial Stability: Options to Deal with Real Estate Booms*. IMF Staff Discussion Note.*

Cuaresma, J.C., Fidrmuc, J., and Hake, M., (2013) Determinants of Foreign Currency Loans in CESEE Countries: A Meta-Analysis. In: Focus on European Economic Integration, *Q4/2011, Österreichische Nationalbank OeNB. 69–87.*

Czech National Bank, (various years) Annual Reports and Monetary Surveys www.cnb.cz.

De Freitas, M., (2004) The Dynamics of Inflation and Currency Substitution in a small Open Economy. *Journal of International Money and Finance, Vol. 23, pp. 133–142.*

De Haas, R., and Van Lelyveld, I., (2006) Foreign banks and credit stability in Central and Eastern Europe. A panel data analysis. *Journal of Banking & Finance, Vol. 30, No. 7, pp. 1927–1952.*

De Nicolo, G., Honohan, P., and Ize, A., (2005) Dollarization of bank deposits: Causes and consequences. *Journal of Banking and Finance, Vol. 29, No. 7, pp. 1697-1727.*

De Nicolo, G., Ize, A., and Honohan, P., (2003) Dollarization of the banking system: good or bad? *International Monetary Fund Working Paper,* No. 146.

Dell'Ariccia, G., Bakker, B.B., Laeven, L., Vandenbussche, J., Deniz Igan, D., and Tong, H., (2012) Policies for Macrofinancial Stability; How to Deal with Credit Booms. *International Monetary Fund (IMF) Staff Discussion Notes, No. 06.*

Denzin, N.K., (1989) *The Research Act: A Theoretical Introduction to Sociological Methods (3rd ed.).* Prentice Hall, Englewood Chffs, New Jersey.

Denzin, N.K. and Lincoln, Y.S., (2000) *Handbook of Qualitative Research (2nd ed.).* SAGE Publications, Inc, Thousand Oaks, CA.

DeYoung, R., and Hasan, I., (1998) The performance of de novo commercial banks: A profit efficiency approach*. Journal of Banking & Finance, Vol. 22, pp. 565-587.*

Diamond, D., (1984) Financial Intermediation and Delegated Monitoring. The *Review of Economic Studies Vol. 51, No. 3, pp. 393-414.*

Dornbusch, R., (1998) International Financial Crises. *CES- Ifo Working Paper, No. 926.*

Dornbusch, R., and Reynoso, A., (1989) Financial factors in economic development. *National Bureau of Economic Research Working Paper, No. 2889.*

Douglas A.D., (2004) *Multilevel Modeling.* SAGE Publication Ltd, Thousand Oaks, CA.

Druck, P., Moron, E., and Stein, E., (2001) The Twin Risks in the Dollarization Debate: Country and Devaluation Risks, Universidad Del Cema.

EBRD European Bank for Reconstruction and Development (various years), Transition Report, London.

Edwards, S., (2002) The Great Exchange Rate Debate after Argentina. *North American Journal of Economics and Finance, Vol. 13, No. 3, pp. 237-252.*

Eichengreen, B., (2001) What Problems Can Dollarization Solve? *Journal of Policy Modelling, Vol. 23, No. 3, pp. 267-277.*

Eichengreen, B., (2002) When to Dollarize. *Journal of Money, Credit and Banking, Vol. 34, No. 1, pp. 1-24.*

Eichengreen, B., and Hausmann, R., (1999) Exchange Rates and Financial Fragility in New Challenges for Monetary Policy: *Federal Reserve Bank of Kansas City, pp. 329-68.*

Eisenbeis, R., Ferrier, G., & Kwan, S. (1999). The informativeness of stochastic frontier and programming frontier efficiency scores: Cost efficiency and other measures of bank holding performance. *Federal Reserve Bank of Atlanta ,Working Paper Series, No.23.*

Engineer, M., (2000) Currency Transactions Costs and Competing Fiat Currencies. *Journal of International Economics, Vol.52, p.113-136.*

Esti Pank, (various years) Annual Reports and Monetary Surveys www.eestipank.ee

Fang, Y., Hasan, I., and Marton, K., (2011) Bank efficiency in transition economies: recent evidence from South-Eastern Europe. *Research Discussion Papers Bank of Finland.*

Farrell, M., (1957) The measurement of productive efficiency. *Journal of the Royal Statistical Society, Series A. 120, pp. 253–281*

Federico, P., Vegh, C.A., and Vuletin, G., (2012) Macroprudential policy over the business cycle. *Working Paper, University of Maryland.*

Feige, E., (2003) Dynamics of Currency Substitution, Asset Substitution and De Facto Dollarisation and Euroisation in Transition Countries, *Comparative Economic Studies, Vol. 45, No.3, pp. 358–83.*

Feige, E., and Dean, J., (2004) Dollarization and Euroization in Transition Countries: Currency Substitution, Asset Substitution, Network Externalities, and Irreversibility, in V. Alexander, J. Melitz & G. M. von Furstenberg (eds), *Monetary Unions and Hard Pegs: Effects on Trade, Financial Development, and Stability*. Oxford University Press, New York and Oxford, pp. 303–319.

Fethi, M.D., and Pasiouras, F., (2010) Assessing bank efficiency and performance with operational research and artificial intelligence techniques: A survey. *European Journal of Operational Research, Vol. 204, pp.189-198.*

Fidrmuc, J., Hake, M., and Stix, H., (2013) Households' foreign currency borrowing in Central and Eastern Europe. *Journal of Banking and Finance, Vol. 37, pp.1880–1897.*

Fine, M., Weis, L., Weseen, S. and Wong, L., (2000) For Whom: Qualitative Research, Representations, and Social Responsibilities*. In* Denzin, N.K., and Lincoln, Y.S*. (2000) Handbook of Qualitative Research (2nd ed.).* SAGE Publications Inc, Thousand Oaks, CA.

Finlay, L., (2002) *Negotiating the swamp: the opportunity and challenge of reflexivity in research practice.* SAGE Publications Ltd, London England.

Fiordelissi, F., Marques-Ibanez, D., and Molyneoux, P., (2011) Efficiency and risk in European banking. *Journal of Banking and Finances, Vol. 35, pp. 1315-1326.*

Fischer, S., (1982) Seigniorage and Fixed Exchange Rates: An Optimal Inflation Tax Analysis. *Journal of Political Economy 90, no. 2 (April): 295-313. Reprinted in Stanley Fischer, Indexing, Inflation, and Economic Policy (*Cambridge, Mass.: MIT Press, 1987).

Fischer, S., Sahay, R., and Veigh, C., (1996) Economies in transition: the Beginnings of Growth. *American Economic Association Papers and Proceedings, Vol. 86, pp. 229-233.*

Flick, U., (1992) Triangulation revisited: strategy of validation or alternative? *Journal for the Theory of Social Behaviour, Vol. 22, No. 2, pp. 175-97.*

Flick, U., (2002) *An Introduction to Qualitative Research.* SAGE Publications, Inc, London England.

Flood, P.R., and Rose, K.A., (1999) Understanding Exchange Rate Volatility Without the Contrivance of Macroeconomics. *The Economic Journal, Vol. 109, No. 459, pp. 660–672.*

Forsund, F.R., Lovell, C.A.K., and Schmidt, P., (1980) A survey of frontier production functions and of their relationship to efficiency measurement. *Journal of Econometrics, Vol. 13, pp. 5-25.*

Frankel, J., and Rose, A., (1998) The endogeneity of the optimum currency area criteria. *The Economic Journal, Vol.108, pp.1009-25.*

Frankel, J., and Rose, A., (2002) An Estimate of the Effect of Common Curencies Unions on Trade and Income. *Quarterly Journal of Economics, Vol. 117, No. 2, pp. 437-466.*

Fried, H., Lovell, C., Schmidt, S., and Yaisawarng, S., (2002) Accounting for environmental effects and statistical noise in data envelopment analysis. *Journal of Productivity Analysis, Vol. 17, pp. 157–174.*

Fried, H., Lovell, K., and Schmidt, S., (2007) *The Measurement of Productive Efficiency and Productivity*. *Oxford University Press, the Red Book.*

Fries, S., and Taci, A., (2005) Cost Efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. *Journal of Banking and Finance, Vol. 29, No. 1, pp. 55-81.*

Galati, G., and Moessner, R., (2014) What do we know about the effects of macroprudential policy? De *Nederlandsche Bank DNB Working Paper, No. 440.*

Galindo, A., and Leiderman, L., (2006) Living with Dollarization and the route to Dedollarization. *Inter-American Development Bank, Research Department, Working Papers, No. 4397.*

Gallant, R., (1982) The Fourier Flexible Form. *American Journal of Agricultural Economics, Vol. 66, No. 2, pp.204-208.*

Ghosh, S., (2013) Macroprudential Regulation and Bank Performance: Evidence from India. *Munich Personal RePEc Archive MPRA Paper No. 51226.*

Gilbert, N., (2008) *Researching social life (3rd ed.).* SAGE Publications Ltd, London England.

Gillham, B., (2000) *Developing a Questionnaire (2nd ed.).* Continuum International Publishing Group, London England.

Giovannini, A., and Turtelboom, B., (1994) Currency Substitution in F.van der Ploeg (ed.), *Handbook of International Macroeconomics,* Mass: Blackwell, Cambridge.

Girardone, C., Nankervis, J.C., and Velentza, E., (2009) Efficiency, ownership and financial structure in European banking. *Managerial Finance, Vol. 35, No. 3, pp. 227–245.*

Goldstein, M., and Turner, P., (2004) Banking crises in emerging economies; Origins and policy options. *Bank for International Settlements, BIS Economic papers, No. 46.*

Gomis-Porqueras, P., Serrano, C., and Somuano, J., (2000) Currency Substitution in Latin America: Lesson from the 1990s, *World Bank Publications.*

Gordon, R.L., (1975) *Interviewing: Strategy, Techniques and Tactics*. Dorsey Press, Illinois.

Greene, W.. (2002) Limdep Version 8.0: Econometric Modelling Guide, *Plainview Econometric Software, Inc Vol. 2.*

Greene, W., (1990) A Gamma-Distributed Stochastic Frontier Model. *Journal of Econometrics, Vol. 46, pp. 141.*

Greene, W., (2003; 5th Ed.) Econometric Analysis. *Prentice Hall, New Jersey.*

Greene, W., (2005a) Reconsidering heterogeneity in panel data estimators of the stochastic frontier model. *Journal of Econometrics, Vol. 126, pp. 269-303.*

Greene, W., (2005b) Fixed and random effects in stochastic frontier models. *Journal of Productivity Analysis, Vol. 23, pp. 7-32.*

Greene, W., (2007) Functional form and heterogeneity in models for data. *Foundations and Trends in Econometrics, Vol. 1, pp. 113-218.*

Greene, W., (2008) *The Measurement of Efficiency,* chapter in *The Econometric Approach to Efficiency Analysis*. Oxford University Press.

Grigorian, D., and Manole, V., (2002) Determinants of Commercial Bank Performance in Transition: An Application of Data Envelopment Analysis. *World Bank Working Paper, No. 2850.*

Grigorian, D., and Manole, V., (2006) Determinants of Commercial Bank Performance in Transition: An Application of Data Envelopment Analysis. C*omparative Economic Studies Vol. 48, No. 3, pp. 497–522.*

Gruben, W., and Welch, J., (1996) Default Risk and Dollarization in Mexico. *Journal of Money, Credit and Banking, Vol. 28, No. 3, pp. 393-401.*

Guarda, P., Rouabah, A., abd Vardanyan, M., (2013) Identifying bank outputs and inputs with a directional technology distance function. *Journal of Productivity Analysis, Vol. 40, No.2, pp. 185-195.*

Guilde, A., Hoelscher, D., Ize, A., Marton, D., and De Nicolo G., (2004) Financial Stability in Dollarized Economies. *International Monetary Fund Occasional Paper, No. 230.*

Haiss, P., and Rainer, W., (2012) Credit euroization in CESEE: The "Foreign Funds" channel at work. *Comparative Economic Studies, Vol. 54, No. 3, pp. 471–505.*

Haiss, P., Paul Hart, A., and Rainer, W., (2009) Do foreign banks drive foreign currency lending in Central and Eastern Europe? *Paper presented at the 6th Annual*

INFINITI Conference on International Finance, June 9-10, Trinity College, Dublin, Ireland.

Hake, M., and Lopez-Vicente, F., (2014) Do the drivers of loan dollarization differ between CESEE and Latin America? A meta-analysis. *Banco de Espana, Eurosystem, No. 1406.*

Hallam, D., and Machado, F., (1996) Efficiency Analysis with Panel Data: A Study of Portuguese Dairy Farms. *European Review of Agricultural Economics, Vol. 23, pp. 79-93.*

Hammersley, M., and Atkinson, P., (1995) *Ethnography: Principles in practice (2nd ed.).* Routledge Ltd, New York New York.

Hammersley, M., and Traianou, A., (2012) *Ethics in Qualitative Research: Controversies and Contexts.* SAGE Publications Ltd, London England.

Hasan, I., and Marton, K., (2003) Banking in Transition Economy: Hungarian Evidence. *Journal of Banking and Finance, Vol. 27, pp. 2249-2271.*

Haselmann, R., and Wachtel, P., (2007) Risk taking by banks in the transition countries. *Comparative Economic Studies, Vol. 49, pp.411-29.*

Hatch, J.A., (2002) Doing qualitative research in education settings. *Albany: State. University of New York Press.*

Healy, M. and Perry, C., (2000) Comprehensive criteria to judge validity and reliability of qualitative research within realism paradigm. *Qualitative Market Research: An International Journal, Vol. 3 No. 3, pp. 118-26.*

Honig, A., (2005) Fear of Floating and Domestic Liability Dollarization. *Emerging Markets Review, Vol. 6, No. 3, pp. 289-307.*

Honig, A., (2009) Dollarization, exchange rate regimes and government quality. *Journal of International Money and Finance, Vol. 28, No. 2, pp. 198-214.*

Honohan, P., (2007) Dollarization and Exchange Rate Fluctuations. *World Bank Policy Research, Working Paper, No. 4172.*

Honohan, P., and Shi, A., (2002) Deposit Dollarization and the Financial Sector in Emerging Economies. *The World Bank Series Policy Research, Working Paper, No. 2748.*

Houston, J., Lin, C., Lin, P., and Ma, Y., (2010) Creditor rights, information sharing, and bank risk taking. *Journal of Financial Economics, Vol. 96, pp. 485–512.*

Hughes, J., and Mester, L., (1993) A quality and risk-adjusted cost function for banks: Evidence on the 'Too-Big-to-Fail' doctrine*. Journal of Productivity Analysis, Vol. 4, pp. 293–315.*

Hughes, J., and Mester, L., (1998) Bank capitalization and cost: Evidence of scale economies in risk management and signaling. *The Review of Economics and Statistics, Vol. 80, pp. 314–325.-163.*

Hughes, J., and Mester, L., (2008) Efficiency in Banking: Theory, Practice and Evidence. *Oxford Handbook of Banking.*

IMF International Monetary Fund (2011a) Macroprudential Policy: An Organizing Framework. Background Paper.

IMF International Monetary Fund (2011b) Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences. Background Paper.

IMF International Monetary Fund (2014) Global Macroprudential Policy Instruments Database.

IMF, BIS, FSB, (2009) Guidance to Assess the Systemic Importance of Financial Institutions, Markets and Instruments: Initial Considerations. *Briefing Paper for the G20 Finance Ministers and Central Bank Governors, October 28, 2009.*

Irsova, Z., (2010) Bank Efficiency in Transitional Countries: Sensitivity to Stochastic Frontier Design. *William Davidson Institute Working Paper, No. 998*

Ivanov, M., Tkalec, M., and Vizek, M., (2011) The Determinants of Financial Euroization in a Post-Transition Country: Do Threshold Effect Matter? *Czech Journal of Economics and Finance, Vol. 61, No. 3.*

Ize, A., and Levy Yeyati, E., (2003) Financial dollarization. *Journal of International Economics, Vol. 59, No. 2, pp. 323-347.*

Ize, A., and Levy-Yeyati, E., (1998) Dollarization and Financial Intermediation: Causes and Policy Implications. *International Monetary Fund Working Paper, No.22.*

Ize, A., and Parrado, E., (2002) Dollarization, Monetary Policy, and the Pass-Through*. International Monetary Fund Working Paper, No.188*.

Ize, A., and Parrado, E., (2006) Real Dollarization, Financial Dollarization, and the Monetary Policy. *Central Bank of Chile Working Paper, No. 375.*

Jacome, L., (2004) The Late 1990s Financial Crisis in Ecuador: Institutional Weaknesses, Fiscal Rigidities and Financial Dollarization at Work*. International Monetary Fund Working Paper, No.12.*

Jacome, L., and Lonnberg, A., (2010) Implementing Official Dollarization. *International Monetary Fund Working Paper, No.106.*

Jeanne, O., (2003) Why do emerging market economies borrow in Foreign currency? *International Monetary Fund, Working Paper, No.177.*

Jemric, I., and B. Vujcic (2002) Efficiency of Banks in Croatia: A DEA Approach. *Croatian National Bank, Working Paper, No.7.*

Kasman, A., (2005) Efficiency and Scale Economies in Transition Economies: Evidence from Poland and the Czech Republic. *Emerging Markets Finance and Trade, Vol. 41, No. 2, pp. 60–81.*

Kasman, A., and Yildirim, C., (2006) Cost and profit efficiencies in transition banking: the case of new EU members. *Applied Economics, Vol. 38, pp.1079-1090.*

King, R., and Levine, R., (1993a) Finance and Growth: Schumpeter Might Be Right. *Quarterly Journal of Economics, Vol. 108, No. 3, pp. 717-37.*

King, R., and Levine, R., (1993b) Financial Intermediation and Economic Development, in: Financial intermediation in the construction of Europe. *Eds.:COLIN MAYER AND XAVIER VIVES. London: Centre for Economic Policy Research, pp.156-89.*

King, R., and Levine, R., (1993c) Finance, Entrepreneurship, and Growth: Theory and Evidence. *J. Monet. Econ. Vol. 32, No. 3, pp. 513-42.*

Koenker, R., (2004) Quantile regression for longitudinal data. *Journal of Multivariate Analysis, Vol. 91, pp. 74 – 89.*

Komarek, L., and Melecky, M., (2003) Currency Substitution in a Transitional Economy with an Application to the Czech Republic. *Eastern European Economics, Vol. 41, No. 4, pp. 72-79.*

Kotios, A., (2002) Southeastern Europe and the Euro Area: the Euroization Debate. *Eastern European Economics Vol. 40, No. 6, pp. 24-50.*

Kotzian, P., (2005) Productive Efficiency and Heterogeneity of Health Care Systems: Results of a Measurement for OECD Countries. *Working Paper, London School of Economics, London.*

Koutsomanoli-Filipaki, A., Margaritis, D., and Staikouras, C., (2009) Efficiency and productivity growth in the banking industry of Central and Eastern Europe. *Journal of Banking and Finance, Vol 33, pp. 557-567.*

Kraft, E., and Tirtiroglu, D., (1998) Bank efficiency in Croatia: A Stochastic - Frontier Analysis. *Journal of Comparative Economics, Vol. 26, No. 2 p. 282 - 300.*

Kraft, E., Hofler, R., and Payne, J., (2002) Privatization, foreign bank entry and bank efficiency in Croatia: A Fourier-flexible function stochastic cost frontier function analysis. *Croatian National Bank, Working Paper, No. 9.*

Krugman, P., (1999) Balance Sheets, the Transfer Problem, and Financial Crises. *International Tax and Public Finance* Vol. 6, No. 4, pp. 459-472.

Kumamoto, H., and Kumamoto, M., (2014) Does Currency Substitution Affect Exchange Rate Volatility? *International Journal of Economics and Financial Issues, Vol. 4, No. 4, pp.698-704.*

Kumbhakar, S., (1990) Production Frontiers, Panel Data, and Time-Varying Technical Inefficiency. *Journal of Econometrics, Vol. 46, No.2, pp. 201-212.*

Kumbhakar, S., and Lovell, C., (2003ed.) *Stochastic Frontier Analysis.* University Press, Cambridge.

Kumbhakar, S.C., Ghosh, S., and McGuckin, J.T., (1991) A Generalized Production Frontier Approach for Estimating Determinants of Inefficiency in U.S. Dairy Farms." *Journal of Business and Economic Statistics, Vol. 9, pp. 279-286.*

Kutan, A.M., Ozsoz, E., and Rengifo, E.W., (2010) Evaluating The Effects Of Deposit Dollarization In Bank Profitability. *Fordham University Department of Economics* Discussion Paper, No.07.

Kuttner, K., and Shim, I., (2012) Can non-interest rate policies stabilize housing markets? Evidence from a panel of 57 economies. *National Bureau of Economic research working paper No. 19723.*

Kvale, S., (1996) *InterViews: An introduction to qualitative research interviewing*. SAGE Publications Ltd, Thousand Oaks, CA.

Kwan, S.H., (2006) The X-efficiency of commercial banks in Hong Kong. *Journal of Banking and Finance. Vol. 30, No. 4, pp. 1127-1147.*

Laeven, L., and Levine, R., (2009) Bank governance, regulation and risk taking. *Journal of Financial Economics, Elsevier, Vol. 93, No. 2, pp. 259-275.*

Lahiri, A., and Veigh, C., (2001) Living with the Fear of Floating: An Optimal Policy Perspective. *National Bureau of Economic Research, Working Paper No. 8391.*

Lancaster, T., (2002) The Incidental Parameters Problem Since 1948. *Journal of Econometrics, Vol. 95, pp. 391-414.*

Lee, Y., and Schmidt, P., (1993) A Production Frontier Model with Flexible Temporal Variation in Technical Inefficiency. In Fried, H., and Lovell, K., eds., *The Measurement of Productive Efficiency: Techniques and Applications*, Oxford University Press, New York.

Leedy, P. D., and Ormrod, J. E., (2005) *Practical research: Planning and design (8th ed.).* Prentice Hall Ltd, Upper Saddle River, NJ.

Levi Yeyati, E., (2006) Financial Dollarisation: Evaluating the Consequences. *Economic Policy, Vol. 21, No. 45, pp. 63-118.*

Levine, R., (1997) Financia Development and Economic growth: Views and Agenda. *Journal of Economic Literature, Vol. 35, No. 2, pp. 688-726*

Levy Yeyati, E., and Sturzenegger, F., (2001) Dollarization: A Primer. *Cambridge and London: MIT Press: 1-5.*

Levy-Yeyati, E., (2004) Dollars, Debts and the IFIs: De-dollarizing Multilateral Lending, *CIF Working Paper, No. 11 (Buenos Aires: Universidad Di Tella).*

Levy-Yeyati, E., and Sturzenegger. F., (2007) Fear of floating in reverse: exchange rate policy in the 2000s. *Department of Economics, Universidad Torcuato di Tella, Buenos Aires.*

Lim,C., Columba, F., Costa, A.,Kongsamut, P., Otani, A., Saiyid, M., Wezel, T., and Wu,X., (2011). Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences. *International Monetary Fund Working Paper No. 238.*

Lincoln, Y.S., (2009) Ethical practices in qualitative research. In Mertens, D. M., and Ginsberg, P. E. *The handbook of social research ethics (pp. 150–169).* SAGE Publications Ltd, Los Angeles CA.

Lincoln, Y.S., and Guba, E.G., (1985*) Naturalistic inquiry.* SAGE Publications Ltd, Beverly Hills, CA.

Lipson, J.G., (1994) *Ethical issues in ethnography. In Morse, J. M. Critical issues in qualitative research methods.* SAGE Publications Ltd, Thousand Oaks CA.

Lozano-Vivas, A., and Pasiouras, F., (2010) The impact of non-traditional activities on the estimation of bank efficiency: International evidence. *Journal of Banking & Finance, Vol. 34, pp.1436-1449.*

Lozano-Vivas, A., Pastor, J.T., and Pastor, J.M., (2002) An efficiency comparison of European banking systems operating under different environmental conditions. *Journal of Productivity Analysis, Vol.18, pp. 59-77.*

Luca, A., and Petrova, I., (2003) Credit Dollarization in Transition Economies: Is it Firms' or Banks' Fault? *Mimeo Drexel University.*

Luca, A., and Petrova, I., (2008) What drives credit dollarization in transition economies? *Journal of Banking and Finance, Vol. 32, No. 5, pp. 858-869.*

Luke, D. A., (2004) *Multilevel Modeling.* SAGE Publications Ltd, Thousand Oaks CA.

Mamatzakis, E., Staikouras, C., and Koutsomanoli-Filipaki, A., (2008) Bank efficiency in the new European Union member states: Is there convergence? *International Financial Markets, Institutions and Money, Vol. 17, pp. 1156-1172.*

Marshall, C., and Rossman, G.B., (2006) *Designing qualitative research (4th ed.).* SAGE Publications Ltd, Thousand Oaks, CA.

Mastromarco, C., (2008) Stochastic Frontier Models. *Department of Economics and Mathematics-Statistics, CIdE University of Salento.*

Matousek, R., and Taci, A., (2002) Banking efficiency in transition economies: Empirical evidence from the Czech Republic. *Discussion Paper No. 02-3, Centre for International Capital Markets, London Metropolitan University.*

Maudos, J., Pastor, J., Perez, F., and Quesada, J., (2002) Cost and profit efficiency in European banks. *Journal of International Financial Markets Institutions and Money, Vol. 12, pp. 33-58.*

Maxwell, J., (1996 Ed.); (2005 Ed.) *Qualitative Research Design: An Interactive Approach.* SAGE Publications Ltd, Thousand Oaks, CA:.

Maxwell, J., (2008) Designing a qualitative study. In Bickman, L., and Rog, D.J. (2008) *The handbook of applied social research methods, second edition.* SAGE Publications Ltd, Thousand Oaks CA:.

McAllister, P., and McManus, D., (1993) Resolving the scale efficiency puzzle in banking. *Journal of Banking and Finance, Vol.17, pp. 389–405.*

McGuirk, A., and Spanos, A., (2009) Revisiting Error Autocorrelation Correction: Common Factor Restrictions and Granger Non-Causality. *Oxford Bulletin of Economics and Statistics, Vol. 71, Issue 2, pp. 273-294.*

Meeusen, W., van dan Broeck, J., (1977) Efficiency Estimation from CobbDouglas Production Functions with Composed Error. *International Economic Review, Vol.18, No.2, pp. 435-444.*

Merriam, S.B., (1998) *Qualitative research, and case study applications in education.* Josey-Bass Publisher, San Francisko.

Mertens, D.M., and Ginsberg, P.E., (2009) *The handbook of social research ethics.* SAGE Publications Ltd, Los Angeles CA.

Mester, L., (1993) Efficiency in the savings and loan industry, *Journal of Banking and Finance, Vol. 17, No. 2-3, pp. 267-286*.

Mester, L., (1996) A study of bank efficiency taking into account risk-preferences. *Journal of Banking and Finance, Vol. 20, pp. 1025–1045.*

Mester, L., (1997) Measuring efficiency at U.S. banks: Accounting for heterogeneity is important. *European Journal of Operational Research, Vol. 98, pp. 230–248.*

Miles, M.B., and Huberman, A.M., (1994) *Qualitative data analysis: A sourcebook of new methods (2nd ed.).* SAGE Publications Ltd, Thousand Oaks, CA.

Mokhtar, H., AlHabshi, S., and Abdullah, N., (2006) A Conceptual Framework for and Surey of Banking Efficiency Study. *Unitar E-Journal Vol. 2, No 2.*

Mouton, J., (1996) *Understanding Social Research.* Pretoria: JL Van Schaik Publishers.

Murillo-Zamorano, L., (2004) Economic Efficiency and Frontier Techniques*. Journal of Economic Surveys, Vol. 18, No. 1.*

Murillo-Zamorano, L., and Vega-Cervera, J., (2001) The use of parametric and nonparametric frontier methods to measure the productive efficiency in the industrial sector: A comparative study. *International Journal of Production economics, Vol. 69, No. 3, pp. 265-275.*

Murray, J.D., and White, R.W., (1983) Economies of Scale and Economies of Scope in Multiproduct Financial Institutions: A Study of British Columbia Credit Unions. *Journal of Finance, Vol. 38, pp. 887–902*

National Bank Of Georgia, (various years) Annual Reports and Monetary Surveys www.nbg.gov.ge.

National Bank of Moldova, (various years) Annual Reports and Monetary Surveys www.bnm.org

National Bank of Poland, (various years) Annual Reports and Monetary Surveys www.nbp.pl.

National Bank of Romania, (various years) Annual Reports and Monetary Surveys www.bnr.ro.

National Bank of Serbia (various years) Annual Reports and Monetary Surveys www.nbs.rs.

National Bank of Slovakia, (various years) Annual Reports and Monetary Surveys www.nbs.sk.

National bank of Tajikistan, (various years) Annual Reports and Monetary Surveys www.nbt.tj.

National Bank of the Kyrgyz Republic, (various years) Annual Reports and Monetary Surveys www.nbkr.kg.

National Bank of the Republic of Belarus, (various years) Annual Reports and Monetary Surveys www.nbrb.by.

National Bank of the Republic of Macedonia, (various years) Annual Reports and Monetary Surveys www.nbrm.mk.

National Bank of Ukraine, (various years) Annual Reports and Monetary Surveys www.bank.gov.ua.

Neanidis, K.C., (2010) Financial Dollarization and European Union Membership. *International Finance, Wiley Blackwell, Vol. 13, No. 2, pp. 257-282.*

Neanidis, K., and Sava, C., (2009) Financial Dollarization: Short Run Determinants in transition Economies. *Centre for Growth and Business Cycle Research, economic Studies, University of Manchester, Working Paper, No. 113.*

Neyman, J., Scott, E.L., (1948) Consistent estimation from partially consistent observations. *Econometrica, Vol.16, pp.1-32.*

Nikiel, E., and Opiela, T., (2002) Customer Type and Bank Efficiency in Poland: Implications for Emerging Banking Market. *Contemporary Economic Policy, Vol. 20, No. 3, pp. 255–271.*

Opiela, T., (2000) Assessing the evaluation of Polish commercial banks. *National Bank of Poland, Paper, No. 18.*

Orea, L., and Kumbhakar, S.C., (2004) Efficiency measurement using a latent class stochastic frontier model. *Empirical Economics, Vol. 29, No. 1, pp. 69–183.*

Ozsoz, E., (2009) Evaluating the Effects of Deposit Dollarization in Financial Intermediation in Transition Economies. *Eastern European Economics, M.E. Sharpe, Inc., Vol. 47, No.4, pp. 5-24.*

Ozsoz, E., Rengifo, E., and Salvatore, D., (2010) Deposit Dollarization as an Investment Signal in Transition Economies: The Cases of Croatia, the Czech Republic, and Slovakia. *Emerging Markets Finance & Trade, Vol. 46, No. 4, pp. 5–22.*

Padgett, D.K., (2004) *The qualitative research experience.* Wadsworth/Thomson Learning, Belmont, CA.

Parker, L.D., (1994) The Case For Field Studies in Management and Accounting: Towards Informed Policy and Practice in Asia. *Accounting and Business Review, Vol. 1, No. 2, pp. 211-231.*

Pasiouras, F., (2008) Estimating the technical and scale efficiency of Greek commercial banks: the impact of credit risk, off-balance sheet activities, and international operations. *Research in International Business and Finance, Vol. 22, pp. 301–318.*

Pastor, J., (1999) Efficiency and risk management in Spanish banking: a method to decompose risk. *Applied Financial Economics, Vol. 9, pp. 371–384.*

Pastor, J., (2002) Credit risk and efficiency in the European banking system: A three-stage analysis. *Applied Financial Economics, Vol. 12, pp. 895–911.*

Pastor, J.M., and Serrano, L., (2006) The effect of specialization on Banks' Efficiency: An International Comparison. *International Review of Applied Economics, Vol. 20, No. 1, pp. 125-149.*

Pastor, J.M., Perez, F., and Quesada, J., (1997) Efficiency Analysis in Banking Firms: An International Comparison. *European Journal of Operational Research, Vol. 98, No. 2, pp. 395-407.*

Pereira, M.C., and Moreira, S., (2007) A Stochastic Frontier Analysis of Secondary Education Output in Portugal. *Banco de Portugal, No.34.*

Pitt, M., and Lee, L.F., (1981) The Measurement and Sources of Technical Inefficiency in the Indonesian Weaving Industry. *Journal of Development Economics, Vol. 9, pp.43-64.*

Poghosyan, T., and Borovicka, J., (2007) Banking efficiency in emerging economies: The impact of ownership endogeneity and EU accession. *CERGE-EI Discussion Paper, No. 189, pp. 1–39.*

Poghosyan, T., and Poghosyan, A., (2010) Foreign bank entry, bank efficiency and market power in Central and Eastern European Countries*. Economics of Transition, Vol.18, No.3, pp. 571-598.*

Primo, D. M., Jacobssmeier, L.M., and Milyo, J., (2007) Estimating the Impact of State Policies and Institutions with Mixed-Level Data*. State Politics & Policy Quarterly Vol.7, No.4, pp. 446-459.*

Quispe-Agnoli, M., *(2002)* Costs and Benefits of Dollarization, *Conference "Dollarization and Latin America: Quick Cure or Bad Medicine?" Latin American and Caribbean Center, Sumit of the Americas Center, Florida.*

Rajan, R., and L. Zingales, (1998) Financial Dependence and Growth. *The American Economic Review, Vol.88, No.3, pp. 559–586.*

Rao, A., (2005) Cost frontier efficiency and risk-return analysis in an emerging market. *International Review of Financial Analysis, Vol.14, pp. 283–30*

Reinhart, C., Rogoff, K., and Savastano, M., (2003) Addicted to dollars. *National Bureau of Economic Research Working Paper Series No. 10015.*

Reininger, T., Schardax, F., and Summer, M. (2002) Financial System Transition in Central Europe: The First Decade, *Société Universitaire Européenne de Recherches Financières.*

Rennhack, R., and Nozaki, M., (2006) Financial Dollarization in Latin America. *International Monetary Fund Working Paper, No. 7.*

Ritchie, J., and Lewis, J., (2003) Qualitative Research Practice*: A Guide for Social Science Students and Researchers. SAGE Publications Ltd, London England.*

Roaf, J., Atoyan, R., Joshi, B., and Krogulski, K., (2014) 25 Years of Transition Post-Communist Europe and the IMF, Regional Economic Issues*, International Monetary Fund IMF Special Report.*

Rochon, L., and Rossi, S., (2003) Modern Theories of Money: the nature and role of money in capitalist economies*. Edward Elgar Publishing Limited, Cheltenham, UK.*

Rogers, K., (1998) Nontraditional activities and the efficiency of US commercial banks. *Journal of Banking and Finance, Vol. 22, pp. 467-482.*

Roodman, D., (2006) How to do xtabond2: An introduction to "difference" and "system" GMM in Stata. *Center for Global Development Working Paper No. 103.*

Roodman, D., (2007) A short note on the theme of too many instruments. *Centre for Global Development Working Paper No. 125.*

Roodman, D., (2008) A note on the theme of too many instruments. *Oxford Bulleting of Economics and Statistics Vol. 71, pp. 135-158.*

Roodman, D., (2009) How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal, Vol. 9, No. 1, pp. 86-136.*

Rose, A., and Engel, C., (2000) Currency Unions and international integration. The *National Bureau of Economic Research NBER Working Paper, No. 7872.*

Rosenberg, C., and Tirpak, M., (2008) Determinants of Foreign Currency Borrowing in the New Member States of the EU," *International Monetary Fund Working Paper No.173.*

Sahay, R., and Veigh, C., (1995) Dollarization in Transition Ecoonomies. *Finansije Vol. 50, No. 9-10, pp. 635-641.*

Sanchez, A., (2006) Financial dollarization, the portfolio approach and expectation: Evidence for Latin America (1995-2005). *Central bank of Peru and University of Oxford Working Paper, No. 10.*

Sandelowksi, S., (1995) Sample size in qualitative research. *Research in Nursing & Health, Vol. 18, No.2, pp. 179–183.*

Santos, J.A., (2000) Bank Capital Regulation in Contemporary Banking Theory: A Review of the Literature. *Bank for International Settlements (BIS) Monetary and Economic Department Working Paper, No. 90.*

Sarafidis, V., Yamagata, T., and Robertson, D., (2009) A Test of Cross Section Dependence for a Linear Dynamic Panel Model with Regressors*. Journal of Econometrics, Vol. 148, No. 2, pp. 149-161.*

Sargan, J.D., (1964) The maximum Likelihood Estiamtion of Economic Relationships with Autoregressive Residual. *Econometrica, Vol. 29, pp. 414-426.*

Saunders, M., Lewis, P., and Thornhill, A., (2003) *Research method for business students, (3rd ed.)* Prentice Hall, New York New York.

Savastano, M., (1996) Dollarization in Latin America: Recent Evidence and Some Policy Issues. *International Monetary Fund Working Paper,* No.4.

Scheber, T., and Stix, H., (2009) Euroisation in Central Eastern and Southeastern Europe- new Evidence on its Extent and Some Evidence on its Causes. *Osterreichische Nationalbank Eurosystem, Working Paper, No. 159.*

Schmidt, P., and Sickles, C.R., (1984) Production frontiers and panel data. *Journal of Business and Economic Statistics Vol. 2, No. 4, pp. 367–374.*

Schmitt-Grohe, S., and Uribe, M., (2001) Stabilization policy and the costs of dollarization. *Journal of Money, Credit and Banking, Vol. 33, No. 2, pp. 482-509.*

Schuler, K., (2005) Some Theory and History of Dollarization. *Cato Journal, Vol. 25, No.1.*

Schuler, K., and Stein, R., (2000) The mack dollarization plan: *An analysis. Presented at the Federal Reserve Bank of Dallas Conference.* Dollarization: A Common Currency for the Americas?

Sealey, C., and Lindley, J., (1977) Inputs, Outputs, and a Theory of Production and Cost at Depository Financial Institutions, *Journal of Finance, Vol. 32, pp. 1251-1266.*

Seater, J., (2008) The Demand for Currency Substitution. *Economics Discussion Paper No. 2.*

Sena, V., (2003) The Frontier Approach to the Measurement of Productivity and Technical Efficiency. *Working paper, University of Leeds.*

Shinichi, S., (2007) De facto dollarization and its effect on financial development and economic growth of Cambodia, Lao PDR and Viet Nam. *Paper presented at the Conference: Policy Options and Challenges for Developing Asia- Perspectives from the International Monetary Fund and Asia.*

Silverman, D., (2005) *Doing qualitative research: a practical handbook (2nd ed.).* SAGE Publications Ltd, London England.

Silverman, D., (2011) *Qualitative Research (3rd ed.).* SAGE Publications Ltd, London, England.

Simar L., and Wilson P.W., (2007) Estimation and inference in two-stage, semi-parametric models of production processes*. Journal of Econometrics, Vol. 136, No. 1, pp. 31–64.*

Simar, L. and Wilson, P., (2007) Estimation and inference in two-stage, semiparametric models of production processes*. Journal of Econometrics, Vol. 136 No. 1, pp. 31-64.*

Sitx, H., (2009) Euroization: What drives its persistence? Household Data Evidence for Croatia, Slovenia and Slovakia. *Oesterreichische Nationalbank Eurosystem Working Paper, No. 140.*

Staikouras, C., Mamatzakis, E., and Koutsomanoli-Filipaki, A., (2008) Cost efficiency of the banking industry in the South Eastern European region*, International Financial Markets, Institutions and Money, Vol. 18, pp. 483-497.*

Steiner, K., (2011) Households' Exposure to Foreign Currency Loans in CESEE EU Member States and Croatia. In: Focus on European Economic Integration Q1/2011. OeNB pp. 6–24.

Studart, R., (2001) Dollarization: "an intellectual fad or a deep insight"? *Journal of Post Keynesian Economics, Vol. 23, No. 4, pp. 639-661.*

Sturm, J., and Williams, B., (2010) What Determines Differences in Foreign Bank Effciiency? Australian Evidence*. Finance and Corporate Governance Conference.*

Sun, L., and Chang, T., (2011) A comprehensive analysis of the effects of risk measures on bank efficiency: Evidence from emerging Asian countries. *Journal of Banking and Finance, Vol. 35, pp. 1727-1735.*

Sword, W., (1999) Accounting for the presence of self: reflections on doing qualitative research. *Qualitative Health Research, Vol. 9, No. 2, pp. 270-278.*

The Central Bank of Hungary, (various years) Annual Reports and Monetary Surveys www.mnb.hu.

The National Bank of Kazakhstan, (various years) Annual Reports and Monetary Surveys www.nationalbank.kz.

Timmer, C., (1971) Using a probabilistic frontier production function to measure technical efficiency. *Journal of Political Economy, Vol. 79, pp. 776-794.*

Tochkov, K., and Nenovsky, N., (2011) Institutional reforms, EU Accession, and Bank Efficiency in Transition Economies: Evidence from Bulgaria. *Emerging Markets Finance & Trade, Vol. 47, No. 1, pp. 113-129.*

Tovar, C., Garcia-Escribano, M., and Martin, M.V., (2012) Credit Growth and the Effectiveness of Reserve Requirements and Other Macroprudential Instruments in Latin America. *International Monetary Fund IMF Working Paper No. 142.*

Trochim, W. M., (2001) *The research methods knowledge base (2nd ed.).* Atomic Dog Publishing, Ohio Cincinnati.

Trost, J.E., (1986) Statistically nonrepresentative stratified sampling: A sampling technique for qualitative studies. *Qualitative Sociology, Vol. 9, No. 54, pp. 57.*

Van den Broeck, J., Koop, G., Osiewalski, J., and Steel, M.F.J., (1994) Stochastic Frontier Models: A Bayesian Perspective. *Journal of Econometrics, Vol. 61, pp. 273-303.*

Vandenbussche, J., Ursula, V., and Detragiache, E., (2012) Macroprudential Policies and Housing Prices—A New Database and Empirical Evidence for Central, Eastern and Southeastern Europe. *International Monetary Fund (IMF) Working Paper. No. 303.*

Verbeek, M., (2000) *A Guide to Modern Econometrics.* John Wiley & Sons Ltd, Chichester.

Vieira, F.A.C., Holland, M., and Resende, M.F., (2012) Financial Dollarization and Systemic Risks: New Empirical Evidence. *Journal of International Money and Finance, Vol. 13, pp. 1695-1714.*

Wachtel, P., (2001) Growth and finance: what do we know and how do we know it? *International Finance, Vol. 4, No.3, p.353-362.*

Wang, H.J., and Schmidt, P., (2002) One-Step and Two-Step Estimation of the Effects of Exogenous Variables on Technical Efficiency Levels. *Journal of Productivity Analysis, Springer, Vol. 18, No.2, pp. 129-144.*

Weill, L., (2003) Banking efficiency in transition economies: The role of Foreign Ownership. *Economics of Transition, Vol. 11, No. 3, pp. 569-592.*

Weill, L., (2004) Measuring cost efficiency in European banking: A comparison of frontier techniques. *Journal of Productivity Analysis, Vol. 21, pp.133–152.*

Weymoth, S., (2007) Political Institutions, Policy Instability, and Financial Dollarization. *University of California Working Paper.*

Wheelock, D., and Wilson, P., (1995) Explaining Bank Failures: Deposit Insurance, Regulation, and Efficiency. *Review of Economics and Statistics, Vol. 77, pp. 689-700.*

Williams, J., (2004) Determining management behaviour in European banking. *Journal of Banking and Finance, Vol. 28, pp. 2427-2460.*

Windmeijer, F., (2005) A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics, No. 126, pp. 25-51.*

Winkler, A., Mazzaferro, F., Nerlich, C., and Thimann, C., (2004) Official dollarization/euroization: motives, features and policy implications. *European Central Bank Occasional Paper, No. 11.*

Wong, E., Fong, T., Ka-fai Li, and Choi. H., (2011) Loan-to-Value Ratio As a Macroprudential Tool – Hong Kong's Experience and Cross Country Evidence*". Hong Kong Monetary Authority, Working Paper.*

World Bank (2015) World Development Indicators Database.

Yildirim, H., and Philippatos, G., (2007) Efficiency of Banks Recent Evidence from the Transition economies of Europe. *The European Joumal of Finance, Vol. 13, No. 2, pp. 23-143.*

Yin, R. K., (2003) Case study research: Design and method (3rd ed.). *Thousand Oaks, SAGE Publications Ltd, London.*

Zettelmeyer, J., Nagy, P., and Jeffrey, S., (2010) Addressing Private Sector Currency Mismatches in Emerging Europe. *European Bank for Reconstruction and Development (EBRD) Working Paper, No. 115.*

Appendices

Appendix 4.1 The detailed description of the cleaning process of the database

1st step

The database was cleaned in terms of status of the bank:

1. Banks that were bankrupt from the initial periods were removed.

There were 12 banks in total classified as bankrupt since 1997; 1998 and 2000. They were from Croatia, Lithuania, Poland, Romania , Russian Federation, Serbia and Slovenia.

2. Banks that were dissolved from the initial periods were removed

There were 70 banks that were dissolved in the sample. They were cleaned in relation to the date of dissolution. Banks that were inactive sin 1990s and early 2000s were removed sofinally we were left with 30 banks that were dissolved but the earliest data of dissolution was 2005 in two banks and 2008, 2009 and 2010 in others.

3. Banks that were in liquidation were removed.

There were 11 banks in the sample that were in liquidation: most of them since 1996, 1997 and others since early 2000s. All of them were removed.

4. Banks that were inactive with no precision date were removed

There were three banks classified as inactive with no precision date which were removed as well.

5. Banks that were active but with no longer active account on BankScope from the initial periods were removed.

There were 78 banks that were classified as active but had no longer active accounts with Bankscope. They were cleaned in terms of the last account date, 33 banks were finally kept in the sample.

2nd step

The database was cleaned in terms of status of the specialization of the bank:

1. Banks classified as central banks were removed.

There were 26 banks classified as central banks which were removed from the sample.

2. Banks classified as securities firms were removed.

There were two banks classified as securities firms which were removed

3. Banks classified as investment trust corporations were removed

There were 3 banks classified as investment trust corporations which were removed.

4. Banks classified and finance leasing companies were removed

There were 60 banks under this category that were removed.

5. Banks classified and group finance companies were removed.

There was one bank classified as a group finance company that was removed.

6. Banks classified a clearing institutions and custody were removed

There was one banks that was classified as clearing institution and custody that was removed.

7. Banks classified as multilateral government banks were removed.

There was one bank classified as multilateral government bank that was removed.

8. Banks classified as other non-banking credit institutions were removed.

There were three banks classified as other non-banking credit institutions that were removed.

9. Banks classified as micro-finance institutions were removed.

There were 16 banks classified as microfinance institutions; however, 12 of them were subsidiaries of Erste Bank; Intesa Bank and ProCredit bank which operate in SEE countries as commercial banks. The remaining four were micro-finance institutions such as Finca, etc. The above mention ones that the author know for a fact that operate as bank in SEEs were kept and re-classified as commercial banks. The remaining four were removed.

10. Banks classified as private banking and asset management were removed.

There was one bank classified as private banking and asset management which was removed.

3rd step

The database was cleaned in terms of missing data.

1. There were 12 banks from Armenia that were only listed and all of them were completely blank in terms of data. Thus, we had to remove them, which meant loosing Armenia as a country in the final sample.
2. There were 20 banks from Azerbaijan that were only listed and all of them were completely blank in terms of data. Thus, we had to remove them, which meant loosing Azerbaijan as a country in the final sample.
3. There were 10 banks from Georgia that were only listed and all of them were completely blank in terms of data. Thus, we had to remove them, which meant loosing Georgia as a country in the final sample.
4. There were 26 banks from Kazakhstan that were only listed and all of them were completely blank in terms of data. Thus, we had to remove them, which meant loosing Kazakhstan as a country in the final sample.
5. There were 3 banks from Kyrgyz Republic that were only listed and all of them were completely blank in terms of data. Thus, we had to remove them, which meant loosing Kyrgyz Republic as a country in the final sample.
6. There were 4 banks from Tajikistan that were only listed and all of them were completely blank in terms of data. Thus, we had to remove them, which meant loosing Tajikistan as a country in the final sample.
7. There were 2 banks from Turkmenistan that were only listed and all of them were completely blank in terms of data. Thus, we had to remove them, which meant loosing Turkmenistan as a country in the final sample.

There were 13 banks from Uzbekistan that were only listed and all of them were completely blank in terms of data. Thus, we had to remove them, which meant loosing Uzbekistan as a country in the final sample.

4rth step

1. The database was carefully examined for multiple entries for the same bank.

2. The unconsolidated financial reports of commercial banks were choses, since they give the financial data for the bank rather than the holding company.
3. Finally it was checked the accounting standards. International Accounting Standards (IAS) data are used wherever available.
4. Third, a number of dubious observations with negative values for several important variables such as total loans, total cost, total investment and total equity, that could not have been negative, were found. After a careful analysis, it was noted that the negative values were usually four or five observations for the entire variable, thus they were treated as missing observations.

Appendix 4.2 Estimated models through BC95 controlling for euroization at country level

The 4.2a Battesse and Coelli 1995 model estimated controlling for euroization at country level in the frontier

```
. sfpanel lntc lny1 lny2 lnw1 lnw2 lny1lny2 lnw1lnw2 half_lny1lny1
half_lny2lny2 half_lnw1lnw1 half_lnw2lnw2 lny1lnw1 lny1lnw2 lny2lnw1 lny2lnw2
gdp_c inf bsri fo hhi fe_sector  T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13 T14,
cost model (bc95) distribution (tnormal) vce (cluster c_name)


Inefficiency effects model (truncated-normal)       Number of obs =      9930
Group variable: id                                Number of groups =      1401
Time variable: year                             Obs per group: min =         1
                                                               avg =       7.1
                                                               max =        14

                                                    Prob > chi2   =    0.0000
Log pseudolikelihood = -7502.0273                   Wald chi2(18)  = 641986.11

                                  (Std. Err. adjusted for 18 clusters in c_name)
------------------------------------------------------------------------------
             |               Robust
        lntc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Frontier     |
        lny1 |   .3910001   .0529291     7.39   0.000      .287261    .4947392
        lny2 |   .3028052   .0190405    15.90   0.000     .2654866    .3401238
        lnw1 |   .8750473   .1426755     6.13   0.000     .5954084    1.154686
        lnw2 |  -.0071694   .0384996    -0.19   0.852    -.0826273    .0682885
     lny1lny2 |  -.0436721   .0027683   -15.78   0.000    -.0490977   -.0382464
     lnw1lnw2 |   .0398369   .0064179     6.21   0.000     .0272581    .0524158
half_lny1lny1 |   .0753817   .0054161    13.92   0.000     .0647663     .085997
half_lny2lny2 |   .0337036   .0033582    10.04   0.000     .0271215    .0402856
half_lnw1lnw1 |  -.0007644   .0096566    -0.08   0.937    -.0196909    .0181622
half_lnw2lnw2 |  -.0360345   .0058779    -6.13   0.000    -.0475549   -.0245141
     lny1lnw1 |   .0043347   .0128181     0.34   0.735    -.0207883    .0294577
     lny1lnw2 |   .0132898   .0039648     3.35   0.001     .0055189    .0210607
     lny2lnw1 |  -.0122904   .0024588    -5.00   0.000    -.0171097   -.0074712
     lny2lnw2 |   .0084779   .0020236     4.19   0.000     .0045116    .0124441
        gdp_c |  -.0000152   9.66e-06    -1.57   0.117    -.0000341    3.77e-06
          inf |  -.0012518   .0025199    -0.50   0.619    -.0061907    .0036871
         bsri |   .0744052   .0846468     0.88   0.379    -.0914994    .2403098
           fo |   -.253709   .1405096    -1.81   0.071    -.5291028    .0216848
          hhi |  -.0000462   .0000354    -1.30   0.193    -.0001157    .0000233
    fe_sector |   .3541581   .1411813     2.51   0.012     .0774479    .6308684
           T2 |   -.076047   .0842097    -0.90   0.366    -.2410949     .089001
           T3 |  -.2465617   .1187861    -2.08   0.038    -.4793782   -.0137451
           T4 |  -.2866108   .1322343    -2.17   0.030    -.5457853   -.0274363
           T5 |  -.4549638   .1511165    -3.01   0.003    -.7511467   -.1587809
           T6 |  -.4497895   .1531467    -2.94   0.003    -.7499515   -.1496274
           T7 |  -.5243696    .156177    -3.36   0.001     -.830471   -.2182683
           T8 |  -.5935073   .1723817    -3.44   0.001    -.9313693   -.2556452
           T9 |  -.1742741   .1470208    -1.19   0.236    -.4624295    .1138813
          T10 |   .0001956   .1642673     0.00   0.999    -.3217623    .3221536
          T11 |   -.245946   .1504244    -1.64   0.102    -.5407724    .0488805
```

```
          T12 |  -.2658592   .1634547    -1.63   0.104    -.5862246    .0545062
          T13 |  -.3113939   .1534303    -2.03   0.042    -.6121118   -.0106761
          T14 |  -.3149513   .1593662    -1.98   0.048    -.6273034   -.0025992
        _cons |    3.89871   .3762834    10.36   0.000     3.161208    4.636212
--------------+------------------------------------------------------------------
Mu            |
        _cons |  -.8715584   .2444152    -3.57   0.000    -1.350603   -.3925133
--------------+------------------------------------------------------------------
Usigma        |
        _cons |  -.3382599   .2100867    -1.61   0.107    -.7500222    .0735024
--------------+------------------------------------------------------------------
Vsigma        |
        _cons |  -2.058819   .1121543   -18.36   0.000    -2.278637      -1.839
--------------+------------------------------------------------------------------
     sigma_u |   .8443992   .0886985     9.52   0.000     .6872817    1.037435
     sigma_v |   .3572179   .0200318    17.83   0.000      .320037    .3987183
      lambda |   2.363821   .0741031    31.90   0.000     2.218582    2.509061
------------------------------------------------------------------------------

. estimates store BC2vce_cluster

. predict BC2vce_cluster, u
(11384 missing values generated)
(11384 missing values generated)
(11384 missing values generated
```

The 4.2b Battesse and Coelli 1995 model estimated controlling for euroization at country level in the frontier and risk variables in the inefficiency component

```
. sfpanel lntc lny1 lny2 lnw1 lnw2 lny1lny2 lnw1lnw2 half_lny1lny1
half_lny2lny2 half_lnw1lnw1 half_lnw2lnw2 lny1lnw1 lny1lnw2 lny2lnw1 lny2lnw2
gdp_c inf bsri fo hhi fe_sector  T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13 T14,
cost model (bc95) usigma ( cr or mr) distribution (tnormal) vce (cluster
c_name)

Inefficiency effects model (truncated-normal)       Number of obs =      9599
Group variable: id                                Number of groups =      1365
Time variable: year                             Obs per group: min =         1
                                                               avg =       7.0
                                                               max =        14

                                                    Prob > chi2   =    0.0000
Log pseudolikelihood = -5767.5549                   Wald chi2(18)  = 146971.73

                                (Std. Err. adjusted for 18 clusters in c_name)
------------------------------------------------------------------------------
             |               Robust
        lntc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Frontier     |
        lny1 |    .903138   .0276189    32.70   0.000     .8490059    .9572701
        lny2 |    .128333   .0313551     4.09   0.000     .0668781    .1897879
        lnw1 |   .9524457   .1406054     6.77   0.000     .6768641    1.228027
        lnw2 |   .0017271   .0503688     0.03   0.973    -.0969938    .1004481
    lny1lny2 |  -.0184854   .0047641    -3.88   0.000    -.0278229   -.0091478
    lnw1lnw2 |   .0405835    .004797     8.46   0.000     .0311815    .0499855
```

```
half_lny1lny1 |   .0167496   .0073563     2.28   0.023     .0023316    .0311676
half_lny2lny2 |   .0165544   .0045017     3.68   0.000     .0077313    .0253775
half_lnw1lnw1 |  -.0021009   .0052124    -0.40   0.687     -.012317    .0081151
half_lnw2lnw2 |  -.0375273   .0047302    -7.93   0.000    -.0467984   -.0282563
     lny1lnw1 |  -.0072709   .0137787    -0.53   0.598    -.0342767    .0197349
     lny1lnw2 |   .0142382   .0046807     3.04   0.002     .0050641    .0234123
     lny2lnw1 |  -.0054515   .0013832    -3.94   0.000    -.0081625   -.0027404
     lny2lnw2 |   .0065916     .00133     4.96   0.000     .0039849    .0091982
        gdp_c |  -.0000187   9.00e-06    -2.08   0.038    -.0000363   -1.06e-06
          inf |   .0005101   .0026214     0.19   0.846    -.0046278    .0056479
         bsri |   .1204972   .0747739     1.61   0.107    -.0260569    .2670513
           fo |   -.366516   .1301952    -2.82   0.005     -.621694    -.111338
          hhi |  -.0000327   .0000258    -1.27   0.205    -.0000833    .0000179
    fe_sector |   .3346037   .1464566     2.28   0.022     .0475541    .6216533
           T2 |   -.079673   .0733999    -1.09   0.278    -.2235341    .0641882
           T3 |  -.1649494   .1090924    -1.51   0.131    -.3787665    .0488677
           T4 |  -.1574187   .1262779    -1.25   0.213    -.4049189    .0900815
           T5 |  -.2805369   .1351964    -2.08   0.038     -.545517   -.0155568
           T6 |  -.2724505   .1546482    -1.76   0.078    -.5755554    .0306544
           T7 |  -.3292572   .1541926    -2.14   0.033    -.6314692   -.0270452
           T8 |  -.4039659   .1518337    -2.66   0.008    -.7015545   -.1063773
           T9 |   .0094843   .1559012     0.06   0.951    -.2960763     .315045
          T10 |   .1306431   .1984231     0.66   0.510     -.258259    .5195452
          T11 |  -.1111876   .1613732    -0.69   0.491    -.4274733    .2050981
          T12 |  -.0962737   .1648975    -0.58   0.559    -.4194669    .2269195
          T13 |  -.1476462   .1538987    -0.96   0.337    -.4492822    .1539898
          T14 |  -.1472379   .1600156    -0.92   0.357    -.4608628     .166387
        _cons |   1.455669   .3109775     4.68   0.000     .8461643    2.065174
--------------+------------------------------------------------------------------
Mu            |
        _cons |  -.7033142   .1534879    -4.58   0.000    -1.004145   -.4024833
--------------+------------------------------------------------------------------
Usigma        |
           cr |   .0767311      .0215     3.57   0.000     .0345917    .1188704
           or |  -.0297913   .0054024    -5.51   0.000    -.0403799   -.0192027
           mr |  -.0898995   .0175523    -5.12   0.000    -.1243015   -.0554976
        _cons |   .7727765   .2169797     3.56   0.000     .3475041    1.198049
--------------+------------------------------------------------------------------
Vsigma        |
        _cons |  -2.274719   .1020075   -22.30   0.000    -2.474651   -2.074788
--------------+------------------------------------------------------------------
  E(sigma_u) |   .7967975                                  .7656801    .8279149
     sigma_v |   .3206645   .0163551    19.61   0.000     .2901593    .3543769
------------------------------------------------------------------------------

. estimates store BC4vce_cluster

. predict BC4vce_cluster, u
(11384 missing values generated)
(11384 missing values generated)
(11715 missing values generated)
```

Appendix 4.3 Estimated models through TRE05 controlling for euroization at country level

The 4.2a Greene True Random Effect 2005 model estimated whilst controlling for euroization at country level in the frontier

```
. sfpanel lntc lny1 lny2 lnw1 lnw2 lny1lny2 lnw1lnw2 half_lny1lny1
half_lny2lny2 half_lnw1lnw1 half_lnw2lnw2 lny1lnw1 lny1lnw2 lny2lnw1 lny2lnw2
gdp_c inf bsri fo hhi fe_sector T2 T3 T4 T5 T6 T7 T8 T9 T10  T11 T12 T13 T14,
cost model(tre) distribution (tnormal) nsim(50) simtype(halton) base(7)rescale
vce (cluster c_name)

True random-effects model (truncated-normal)        Number of obs =      9930
Group variable: id                                  Number of groups =      1401
Time variable: year                               Obs per group: min =         1
                                                                  avg =       7.1
                                                                  max =        14

                                                    Prob > chi2   =    0.0000
Log simulated-likelihood = -5531.4080               Wald chi2(18)  =  9.58e+08

Number of Halton Sequences = 50
Base for Halton Sequences  = 7
                                  (Std. Err. adjusted for 18 clusters in c_name)
------------------------------------------------------------------------------
             |               Robust
        lntc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Frontier     |
        lny1 |   .2055112   .0914091     2.25   0.025     .0263527    .3846698
        lny2 |   .3430688   .0398161     8.62   0.000     .2650307    .4211068
        lnw1 |   .8602045   .1158101     7.43   0.000     .6332209    1.087188
        lnw2 |   -.070458   .0368523    -1.91   0.056    -.1426872    .0017712
     lny1lny2 |   -.045037   .0051009    -8.83   0.000    -.0550346   -.0350394
     lnw1lnw2 |   .0310633   .0066508     4.67   0.000      .018028    .0440987
half_lny1lny1 |   .0848906   .0073069    11.62   0.000     .0705693    .0992118
half_lny2lny2 |   .0311675   .0029162    10.69   0.000     .0254519    .0368832
half_lnw1lnw1 |   .0004342   .0095975     0.05   0.964    -.0183766     .019245
half_lnw2lnw2 |  -.0292681   .0075364    -3.88   0.000    -.0440391    -.014497
     lny1lnw1 |  -.0063512   .0087672    -0.72   0.469    -.0235345    .0108321
     lny1lnw2 |   .0188657    .003766     5.01   0.000     .0114845    .0262469
     lny2lnw1 |   -.007974   .0019161    -4.16   0.000    -.0117295   -.0042184
     lny2lnw2 |   .0059133   .0025737     2.30   0.022     .0008689    .0109577
        gdp_c |  -.0000152   .0000132    -1.15   0.248     -.000041    .0000106
          inf |   .0013827   .0012413     1.11   0.265    -.0010501    .0038155
         bsri |   .2250184   .0667006     3.37   0.001     .0942877    .3557491
           fo |  -.0092213    .129266    -0.07   0.943     -.262578    .2441353
          hhi |  -5.37e-06   .0000148    -0.36   0.718    -.0000345    .0000237
    fe_sector |   .5558098    .127669     4.35   0.000     .3055832    .8060365
           T2 |  -.0567754   .0554476    -1.02   0.306    -.1654506    .0518998
           T3 |  -.1967589   .0977235    -2.01   0.044    -.3882933   -.0052244
           T4 |  -.2019765    .097716    -2.07   0.039    -.3934963   -.0104566
           T5 |  -.2623084   .1062856    -2.47   0.014    -.4706245   -.0539924
           T6 |  -.3330621   .1175306    -2.83   0.005    -.5634179   -.1027062
           T7 |  -.3882945   .1386065    -2.80   0.005    -.6599582   -.1166308
           T8 |  -.4360177   .1725506    -2.53   0.012    -.7742107   -.0978248
           T9 |   -.178055   .1542632    -1.15   0.248    -.4804053    .1242954
          T10 |   .0016111   .1404229     0.01   0.991    -.2736128    .2768349
```

```
          T11 |  -.1763488   .1357693    -1.30   0.194    -.4424517    .0897541
          T12 |  -.1207019   .1534536    -0.79   0.432    -.4214653    .1800615
          T13 |  -.1576515   .1487677    -1.06   0.289    -.4492309    .1339279
          T14 |  -.1710949   .1569092    -1.09   0.276    -.4786314    .1364415
        _cons |   4.083293    .656625     6.22   0.000     2.796332    5.370254
--------------+----------------------------------------------------------------
Mu            |
        _cons |  -394.4695   .0813083 -4851.53   0.000    -394.6288   -394.3101
--------------+----------------------------------------------------------------
Usigma        |
        _cons |   4.723153    .000495  9541.54   0.000     4.722182    4.724123
--------------+----------------------------------------------------------------
Vsigma        |
        _cons |  -2.848134   .2382161   -11.96   0.000    -3.315029    -2.38124
--------------+----------------------------------------------------------------
Theta         |
        _cons |   .4614715   .0142132    32.47   0.000     .4336141    .4893289
--------------+----------------------------------------------------------------
     sigma_u |   10.60766   .0026254  4040.33   0.000     10.60251    10.61281
     sigma_v |   .2407329   .0286732     8.40   0.000     .1906121    .3040328
      lambda |   44.06402   .0286187  1539.70   0.000     44.00793    44.12011
------------------------------------------------------------------------------

. estimates store TRE2

. predict TRE2, u
(11384 missing values generated)
(11384 missing values generated)
(11384 missing values generated)

. predict TRE2o, u0
(11384 missing values generated)
(11384 missing values generated)
```

The 4.2b Greene True Random Effect 2005 model estimated whilst controlling for euroization at country in the frontier and risk variables in the inefficiency component

```
. . sfpanel lntc lny1 lny2 lnw1 lnw2 lny1lny2 lnw1lnw2 half_lny1lny1
half_lny2lny2 half_lnw1lnw1 half_lnw2lnw2 lny1lnw1 lny1lnw2 lny2lnw1 lny2lnw2
gdp_c inf bsri fo hhi fe_sector T2 T3 T4 T5 T6 T7 T8 T9 T10  T11 T12 T13 T14,
cost model(tre) distribution (tnormal) usigma (cr or mr) nsim(50)
simtype(halton) base(7) rescale vce (cluster c_name)

True random-effects model (truncated-normal)         Number of obs =      9599
Group variable: id                                 Number of groups =      1365
Time variable: year                              Obs per group: min =         1
                                                                avg =       7.0
                                                                max =        14

                                                    Prob > chi2   =    0.0000
Log simulated-likelihood = -4110.6550               Wald chi2(17)  = 151618.03

Number of Halton Sequences = 50
Base for Halton Sequences  = 7
                                  (Std. Err. adjusted for 18 clusters in c_name)
------------------------------------------------------------------------------
             |               Robust
        lntc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
Frontier     |
         lny1 |   .8369324   .0572305    14.62   0.000     .7247627    .9491021
         lny2 |   .1318219   .0196986     6.69   0.000     .0932134    .1704303
         lnw1 |   .9792558   .1298452     7.54   0.000     .7247638    1.233748
         lnw2 |  -.0524378   .0373238    -1.40   0.160     -.125591    .0207155
     lny1lny2 |  -.0165945   .0024045    -6.90   0.000    -.0213073   -.0118817
     lnw1lnw2 |   .0294636   .0053416     5.52   0.000     .0189942     .039933
half_lny1lny1 |   .0166495   .0034746     4.79   0.000     .0098394    .0234596
half_lny2lny2 |   .0133957   .0015953     8.40   0.000      .010269    .0165224
half_lnw1lnw1 |    .002729   .0077948     0.35   0.726    -.0125485    .0180065
half_lnw2lnw2 |  -.0282318   .0050478    -5.59   0.000    -.0381253   -.0183383
     lny1lnw1 |  -.0194347   .0092811    -2.09   0.036    -.0376253   -.0012441
     lny1lnw2 |   .0166689   .0041969     3.97   0.000     .0084431    .0248947
     lny2lnw1 |  -.0025712   .0011468    -2.24   0.025     -.004819   -.0003234
     lny2lnw2 |   .0058549   .0018214     3.21   0.001      .002285    .0094248
        gdp_c |  -.0000167    .000011    -1.52   0.129    -.0000384    4.88e-06
          inf |   .0018126   .0013463     1.35   0.178    -.0008262    .0044514
         bsri |   .2232963   .0605022     3.69   0.000     .1047141    .3418784
           fo |  -.1395216   .1040996    -1.34   0.180     -.343553    .0645098
          hhi |  -6.52e-06   .0000128    -0.51   0.611    -.0000316    .0000186
    fe_sector |   .5017104   .1097588     4.57   0.000     .2865871    .7168338
           T2 |  -.0691453   .0541889    -1.28   0.202    -.1753535    .0370629
           T3 |  -.1644573   .0774409    -2.12   0.034    -.3162388   -.0126759
           T4 |  -.1833601   .0821241    -2.23   0.026    -.3443204   -.0223999
           T5 |  -.2165509   .0799451    -2.71   0.007    -.3732405   -.0598614
           T6 |  -.2720211   .0890252    -3.06   0.002    -.4465072   -.0975349
           T7 |  -.3372157   .0999419    -3.37   0.001    -.5330982   -.1413331
           T8 |  -.3990571   .1250124    -3.19   0.001    -.6440769   -.1540372
           T9 |  -.1195289   .1128403    -1.06   0.289    -.3406918    .1016341
          T10 |   .0519379   .1285141     0.40   0.686    -.1999452     .303821
          T11 |  -.1574119   .1013945    -1.55   0.121    -.3561414    .0413177
          T12 |  -.1131761   .1138549    -0.99   0.320    -.3363277    .1099754
          T13 |  -.1574578   .1066807    -1.48   0.140    -.3665481    .0516324
          T14 |  -.1560853   .1123093    -1.39   0.165    -.3762075     .064037
        _cons |   1.245488    .522057     2.39   0.017     .2222754    2.268701
-------------+----------------------------------------------------------------
Mu           |
        _cons |  -.2741843   .0782121    -3.51   0.000    -.4274771   -.1208915
-------------+----------------------------------------------------------------
Usigma       |
          cr |   .0447461   .0045907     9.75   0.000     .0357485    .0537436
          or |  -.0652411   .0027336   -23.87   0.000    -.0705988   -.0598833
          mr |  -.0084039   .0211985    -0.40   0.692    -.0499522    .0331444
        _cons |   1.213783   .0625754    19.40   0.000     1.091138    1.336428
-------------+----------------------------------------------------------------
Vsigma       |
        _cons |  -2.798343   .1951946   -14.34   0.000    -3.180918   -2.415769
-------------+----------------------------------------------------------------
Theta        |
        _cons |   .3656624   .0195194    18.73   0.000     .3274052    .4039197
-------------+----------------------------------------------------------------
  E(sigma_u) |   .4601938                                .4479133    .4724743
     sigma_v |   .2468013   .0240871    10.25   0.000     .2038321    .2988288
------------------------------------------------------------------------------

. estimates store TRE3

. predict TRE3, u
(11384 missing values generated)
(11715 missing values generated)
```

```
(11715 missing values generated)

. predict TRE3o, u0
(11384 missing values generated)
(11716 missing values generated)
```

Appendix 4.4 Estimated models through BC95 controlling for euroization at bank level

The 4.2a Battesse and Coelli 1995 model estimated controlling for euroization at bank level in the inefficiency component

```
. . sfpanel lntc lny1 lny2 lnw1 lnw2 lny1lny2 lnw1lnw2 half_lny1lny1
half_lny2lny2 half_lnw1lnw1 half_lnw2lnw2 lny1lnw1 lny1lnw2 lny2lnw1 lny2lnw2
gdp_c inf bsri fo hhi  t2 t3 t4 t5 t6 t7 t8 t9 t10 t11 t12 t13 t14, cost model
(bc95) usigma (fe_bank) distribution (tnormal) vce (cluster c_name)

Inefficiency effects model (truncated-normal)        Number of obs =      1001
Group variable: id                                 Number of groups =       119
Time variable: year                              Obs per group: min =         1
                                                               avg =       8.4
                                                               max =        14

                                                     Prob > chi2   =    0.0000
Log pseudolikelihood =  -238.4960                    Wald chi2(7)  =    416.57

                                  (Std. Err. adjusted for 7 clusters in c_name)
------------------------------------------------------------------------------
             |               Robust
        lntc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Frontier     |
        lny1 |   .2430892   .5939358     0.41   0.682    -.9210036    1.407182
        lny2 |   .4793007   .2580966     1.86   0.063    -.0265592    .9851607
        lnw1 |    1.36185   .4655118     2.93   0.003     .4494636    2.274236
        lnw2 |  -.1466858   .6526763    -0.22   0.822    -1.425908    1.132536
     lny1lny2 |  -.0567303   .0268405    -2.11   0.035    -.1093367   -.0041239
     lnw1lnw2 |   .2008896   .0515088     3.90   0.000     .0999342     .301845
half_lny1lny1 |   .0845435   .0621879     1.36   0.174    -.0373425    .2064295
half_lny2lny2 |   .0425756   .0158968     2.68   0.007     .0114184    .0737327
half_lnw1lnw1 |   -.162898   .0678834    -2.40   0.016    -.2959469    -.029849
half_lnw2lnw2 |  -.1412977   .0941896    -1.50   0.134    -.3259059    .0433105
     lny1lnw1 |  -.0621021   .0503224    -1.23   0.217    -.1607322    .0365279
     lny1lnw2 |   .0468212    .062066     0.75   0.451     -.074826    .1684684
     lny2lnw1 |   .0001348   .0199111     0.01   0.995    -.0388901    .0391598
     lny2lnw2 |   .0145064   .0308286     0.47   0.638    -.0459167    .0749294
        gdp_c |  -9.36e-06   4.72e-06    -1.98   0.047    -.0000186   -1.05e-07
          inf |   .0132871   .0060166     2.21   0.027     .0014948    .0250793
         bsri |  -.1852572   .0744509    -2.49   0.013    -.3311783    -.039336
           fo |   .5091341    .117488     4.33   0.000     .2788618    .7394065
```

```
         hhi |  -.0000248   .0000372    -0.67   0.505    -.0000977    .0000481
          t2 |   .1509387   .0745066     2.03   0.043     .0049085    .2969689
          t3 |  -.0878126   .0908119    -0.97   0.334    -.2658006    .0901754
          t4 |  -.2639472   .1610892    -1.64   0.101    -.5796763    .0517818
          t5 |  -.3130585   .1250977    -2.50   0.012    -.5582454   -.0678716
          t6 |  -.3253451   .1315458    -2.47   0.013      -.58317   -.0675201
          t7 |  -.3013848   .1292617    -2.33   0.020    -.5547331   -.0480364
          t8 |  -.3219744   .1403192    -2.29   0.022     -.596995   -.0469538
          t9 |  -.3287885   .1517937    -2.17   0.030    -.6262987   -.0312784
         t10 |  -.3097805   .1227687    -2.52   0.012    -.5504027   -.0691584
         t11 |  -.3571616   .1425242    -2.51   0.012    -.6365039   -.0778192
         t12 |  -.4539718   .1816916    -2.50   0.012    -.8100807   -.0978628
         t13 |  -.4551972   .1753042    -2.60   0.009    -.7987871   -.1116073
         t14 |  -.4736404   .2075792    -2.28   0.023    -.8804881   -.0667927
       _cons |   4.915675   3.054683     1.61   0.108    -1.071394    10.90274
-------------+----------------------------------------------------------------
Mu           |
       _cons |  -.6634376          .        .       .            .           .
-------------+----------------------------------------------------------------
Usigma       |
     fe_bank |  -.2517109    .460287    -0.55   0.584    -1.153857     .650435
       _cons |  -1.290893   .3350792    -3.85   0.000    -1.947636   -.6341503
-------------+----------------------------------------------------------------
Vsigma       |
       _cons |   -2.92173   .3885121    -7.52   0.000      -3.6832   -2.160261
-------------+----------------------------------------------------------------
  E(sigma_u) |   .4899491                                 .4889747    .4909234
     sigma_v |   .2320354   .0450743     5.15   0.000     .1585635    .3395513
------------------------------------------------------------------------------

. estimates store bc6

. predict bc6, u
(688 missing values generated)
(688 missing values generated)
(763 missing values generated)
```

The 4.2b Battesse and Coelli 1995 model estimated controlling for euroization at bank level and risk variables in the inefficiency component

```
. sfpanel lntc lny1 lny2 lnw1 lnw2 lny1lny2 lnw1lnw2 half_lny1lny1
half_lny2lny2 half_lnw1lnw1 half_lnw2lnw2 lny1lnw1 lny1lnw2 lny2lnw1 lny2lnw2
gdp_c inf bsri fo hhi  t2 t3 t4 t5 t6 t7 t8 t9 t10 t11 t12 t13 t14, cost model
(bc95) usigma (fe_bank cr or) distribution (tnormal) vce (cluster c_name)

Inefficiency effects model (truncated-normal)        Number of obs =       971
Group variable: id                                 Number of groups =       118
Time variable: year                              Obs per group: min =         1
                                                               avg =       8.2
                                                               max =        14

                                                     Prob > chi2   =    0.0000
```

```
Log pseudolikelihood =  -191.9113                     Wald chi2(7)  =    535.72

                                   (Std. Err. adjusted for 7 clusters in c_name)
------------------------------------------------------------------------------
             |               Robust
        lntc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Frontier     |
        lny1 |   .7783362   .5093222     1.53   0.126     -.219917    1.776589
        lny2 |   .2476129   .1904684     1.30   0.194    -.1256983    .6209241
        lnw1 |   1.394737    .415274     3.36   0.001     .5808152    2.208659
        lnw2 |  -.3309803   .5033993    -0.66   0.511    -1.317625    .6556642
    lny1lny2 |  -.0338121   .0227811    -1.48   0.138    -.0784623     .010838
    lnw1lnw2 |   .2242307   .0375093     5.98   0.000     .1507138    .2977475
half_lny1lny1 |   .0261478    .050472     0.52   0.604    -.0727754    .1250711
half_lny2lny2 |   .0361562    .014876     2.43   0.015     .0069997    .0653127
half_lnw1lnw1 |  -.2131058    .045181    -4.72   0.000    -.3016589   -.1245526
half_lnw2lnw2 |   -.147434   .0838373    -1.76   0.079    -.3117521     .016884
    lny1lnw1 |  -.0820603   .0440997    -1.86   0.063    -.1684941    .0043735
    lny1lnw2 |   .0788359   .0481511     1.64   0.102    -.0155384    .1732103
    lny2lnw1 |   .0103893   .0213196     0.49   0.626    -.0313963     .052175
    lny2lnw2 |   .0005763   .0280747     0.02   0.984     -.054449    .0556017
       gdp_c |  -9.33e-06   5.82e-06    -1.60   0.109    -.0000207    2.07e-06
         inf |   .0094575   .0065838     1.44   0.151    -.0034465    .0223616
        bsri |  -.1692893   .0646901    -2.62   0.009    -.2960796    -.042499
          fo |   .5043783   .1245512     4.05   0.000     .2602624    .7484942
         hhi |  -.0000298   .0000415    -0.72   0.473    -.0001111    .0000515
          t2 |    .235196   .0950446     2.47   0.013      .048912      .42148
          t3 |   .0208344   .0821894     0.25   0.800    -.1402539    .1819226
          t4 |   -.180786   .1177166    -1.54   0.125    -.4115063    .0499344
          t5 |   -.229511   .0905145    -2.54   0.011    -.4069162   -.0521059
          t6 |  -.2299933   .1001691    -2.30   0.022     -.426321   -.0336656
          t7 |  -.1966565   .1050687    -1.87   0.061    -.4025874    .0092744
          t8 |  -.2209951   .1167481    -1.89   0.058    -.4498172     .007827
          t9 |  -.2149839   .1398816    -1.54   0.124    -.4891467     .059179
         t10 |  -.2280973   .0944194    -2.42   0.016    -.4131559   -.0430386
         t11 |  -.2795924    .108081    -2.59   0.010    -.4914272   -.0677576
         t12 |  -.3665696   .1463978    -2.50   0.012    -.6535039   -.0796352
         t13 |  -.3782687   .1361375    -2.78   0.005    -.6450933   -.1114441
         t14 |  -.4041463   .1702228    -2.37   0.018    -.7377769   -.0705157
       _cons |    2.40441   2.981185     0.81   0.420    -3.438606    8.247426
-------------+----------------------------------------------------------------
Mu           |
       _cons |   -2.18537   .2608992    -8.38   0.000    -2.696724   -1.674017
-------------+----------------------------------------------------------------
Usigma       |
     fe_bank |   .1295541   .3490257     0.37   0.710    -.5545236    .8136318
          cr |   .0089296   .0179406     0.50   0.619    -.0262333    .0440925
          or |  -.0021865   .0084562    -0.26   0.796    -.0187604    .0143874
       _cons |  -.4458687   .7610189    -0.59   0.558    -1.937438    1.045701
-------------+----------------------------------------------------------------
Vsigma       |
       _cons |  -3.191566   .2768205   -11.53   0.000    -3.734124   -2.649007
-------------+----------------------------------------------------------------
```

```
  E(sigma_u) |   .8054521                                .8030877    .8078164
     sigma_v |   .2027498   .0280626     7.22   0.000     .1545772    .2659349
------------------------------------------------------------------------------
. estimates store bc7

. predict bc7, u
(688 missing values generated)
(688 missing values generated)
```

Appendix 4.5 Estimated models through TRE05 controlling for euroization at bank level

The 4.2a Greene True Random Effect 2005 model estimated whilst controlling for euroization at bank level in the inefficiency component

```
. sfpanel lntc lny1 lny2 lnw1 lnw2 lny1lny2 lnw1lnw2 half_lny1lny1
half_lny2lny2 half_lnw1lnw1 half_lnw2lnw2 lny1lnw1 lny1lnw2 lny2lnw1 lny2lnw2
gdp_c inf bsri fo hhi  t2 t3 t4 t5 t6 t7 t8 t9 t10 t11 t12 t13 t14, cost
model(tre) distribution (tnormal) usigma (fe_bank) nsim(50) simtype (halton)
base(7)rescale vce (cluster c_name)


True random-effects model (truncated-normal)         Number of obs =      1001
Group variable: id                                 Number of groups =       119
Time variable: year                              Obs per group: min =         1
                                                                avg =       8.4
                                                                max =        14

                                                     Prob > chi2   =    0.0000
Log simulated-likelihood =   -34.6472               Wald chi2(7)  =   8043.17

Number of Halton Sequences = 50
Base for Halton Sequences  = 7
                                    (Std. Err. adjusted for 7 clusters in c_name)
------------------------------------------------------------------------------
             |               Robust
        lntc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Frontier     |
        lny1 |    .166386   .0996047     1.67   0.095    -.0288356    .3616075
        lny2 |   .4802405   .0131251    36.59   0.000     .4545158    .5059652
        lnw1 |   1.164188          .        .       .            .           .
        lnw2 |   -.123213          .        .       .            .           .
     lny1lny2 |  -.0515825   .0158332    -3.26   0.001     -.082615     -.02055
     lnw1lnw2 |   .1551022          .        .       .            .           .
half_lny1lny1 |   .0767426   .0223597     3.43   0.001     .0329185    .1205668
half_lny2lny2 |   .0326046          .        .       .            .           .
half_lnw1lnw1 |  -.1300481          .        .       .            .           .
half_lnw2lnw2 |  -.1235042   .0316573    -3.90   0.000    -.1855515    -.061457
```

```
     lny1lnw1 |  -.0604149    .015027    -4.02   0.000    -.0898672   -.0309626
     lny1lnw2 |   .0373369   .0322417     1.16   0.247    -.0258557    .1005296
     lny2lnw1 |   .0015724   .0122387     0.13   0.898     -.022415    .0255598
     lny2lnw2 |   .0151529   .0412581     0.37   0.713    -.0657115    .0960174
        gdp_c |  -.0000181   6.07e-06    -2.98   0.003      -.00003   -6.21e-06
          inf |   .0100323   .0058304     1.72   0.085     -.001395    .0214596
         bsri |   .0084606   .1040682     0.08   0.935    -.1955093    .2124305
           fo |   .0049357   .2371412     0.02   0.983    -.4598526     .469724
          hhi |   .0000515   .0000512     1.00   0.315    -.0000489    .0001519
           t2 |   .1397391   .2086268     0.67   0.503    -.2691619    .5486402
           t3 |    .028855   .2760211     0.10   0.917    -.5121364    .5698464
           t4 |  -.0371208   .3157008    -0.12   0.906    -.6558829    .5816413
           t5 |  -.0526343   .2885519    -0.18   0.855    -.6181857    .5129171
           t6 |  -.0204248    .312836    -0.07   0.948    -.6335722    .5927225
           t7 |   .0519046   .2913644     0.18   0.859    -.5191591    .6229683
           t8 |   .1022181   .3106515     0.33   0.742    -.5066477    .7110839
           t9 |   .0813182   .3346422     0.24   0.808    -.5745684    .7372048
          t10 |   .1006004   .2883775     0.35   0.727    -.4646091      .66581
          t11 |    .040587   .3125576     0.13   0.897    -.5720147    .6531887
          t12 |   .0455695   .3676301     0.12   0.901    -.6749722    .7661112
          t13 |   .0376102    .358486     0.10   0.916    -.6650094    .7402298
          t14 |   .0286283    .395572     0.07   0.942    -.7466785    .8039351
        _cons |   5.093802          .        .       .           .           .
--------------+------------------------------------------------------------------
Mu            |
        _cons |  -74.51911   37.63674    -1.98   0.048    -148.2858   -.7524564
--------------+------------------------------------------------------------------
Usigma        |
      fe_bank |   .6029396   .7621067     0.79   0.429    -.8907622    2.096641
        _cons |   2.212328   .8578673     2.58   0.010     .5309384    3.893717
--------------+------------------------------------------------------------------
Vsigma        |
        _cons |  -3.911606   .3648591   -10.72   0.000    -4.626717   -3.196496
--------------+------------------------------------------------------------------
Theta         |
        _cons |    .302202   .0491728     6.15   0.000     .2058251    .3985789
--------------+------------------------------------------------------------------
  E(sigma_u) |   3.572025                                 3.555565    3.588485
     sigma_v |   .1414508   .0258048     5.48   0.000     .0989284    .2022506
------------------------------------------------------------------------------

.  estimates store tre4

. predict tre4, u
(688 missing values generated)
(763 missing values generated)
(763 missing values generated)

. predict tre4o, u0
(688 missing values generated)
(763 missing values generated
```

Appendix 5.1 The statement letter written in plain language

Business School
Staffordshire University
Plain Language Statement for persons participating in the research project

PROJECT TITLE:

Euroization and its impact on bank efficiency in transition economies: with special reference to South-East European countries

Albulena Xhelili, *PhD Candidate*	***Researcher***	*Business School, Staffordshire University Leek Road, Stoke on Trent ST4 2DF United Kingdom e: A.Xhelili@staffs.ac.uk*
Prof. Dr. Iraj Hashi,	***Supervisor***	*Business School, Staffordshire University Leek Road, Stoke on Trent ST4 2DF United Kingdom e: I.Hashi@staffs.ac.uk*
Prof. Jean Mangan,	***Supervisor***	*Business School, Staffordshire University Leek Road, Stoke on Trent ST4 2DF United Kingdom e: J.T.Mangan@staffs.ac.uk*
Dr. Valentin Toci,	***Supervisor***	*Faculty of Economy, University of Prishtina Rr. Agim Ramadani Prishtina, 10000,Kosovo e: V.Toci@staffs.ac.uk*

Introduction

As someone who has experience in the field of interest for this research, we would like to invite you to participate in our research project. The aim of this research is to investigate the impact of euroization on bank efficiency in European transition economies, with special reference to South-East European countries. The research is undertaken in partial fulfilment of the requirements of Staffordshire University for the award of the degree of Doctor of Philosophy. The project has been approved by the Research Ethics Committee.

What will I be asked to do?

Should you agree to participate, you would be asked to contribute in the following manner. We would ask you to participate in an interview of about 45 minutes, and with your permission, the interview would be recorded so that we can make an accurate record of what you say. When the recording has been transcribed, you would be provided with a copy of the transcript, so that you can verify that the information is correct and/or request deletions. We estimate that the total time

commitment required of you would not exceed 60 minutes*. Please note, you will not be asked for any data, the disscusion will be strictly about policies and procedures.*

How will my confidentiality be protected?

We intend to protect your anonymity and the confidentiality of your responses to the fullest possible extent, within the limits of the law. Your name and contact details and the name of the institution you represent will be kept in a separate, password-protected computer file from any data that you supply. This will only be able to be linked to your responses by the researchers, for example, in order to know where we should send your interview transcript for checking. In the final report, you will be referred to by a pseudonym. We will remove any references to personal information that might allow someone to guess your identity. The data will be kept securely for five years from the date of graduation, before being destroyed.

How will I receive feedback?

Once the thesis arising from this research has been completed, a brief summary of the findings will be available to you, upon request. It is also possible that the results will be presented at academic conferences.

Do I have to take part?

Participation in this study is voluntary. Should you wish to withdraw at any stage, or to withdraw any unprocessed data you have supplied, you are free to do so without prejudice.

Where can I get further information?

Please contact the researchers if you have any questions or if would like more information about the project. The email address is *A.Xhelili@staffs.ac.uk* and the contact telephone number is: +377 44110873.

If you have any concerns about the conduct of the project which you do not wish to discuss with the researcher please contact the above mentioned research supervisors.

How do I agree to participate?

If you would agree to participate, please indicate that you have read and understood this information by signing the consent form and returning it in the envelope provided. The researcher will then contact you to arrange a mutually convenient time for you to complete the interview.

Appendix 5.2 The informed consent form

Business School

Staffordshire University

Consent form for persons participating in the research project

PROJECT TITLE:

Euroization and its impact on bank efficiency in transition economies: with special reference to South-East European countries

Name of participant:

Name of researcher(s):

1. I consent to participate in this research, the details of which have been explained to me, and I have been provided with a written plain language statement to keep.

2. I understand that after I sign and return this consent form, the researcher will retain it.

3. I understand that my participation will involve an ***interview*** and I agree that the researcher may use the results as described in the plain language statement.

4. I acknowledge that:

   (a) the possible effects of participating in the ***interview*** have been explained to my satisfaction;

   (b) I have been informed that I am free to withdraw from the project at any time without explanation or prejudice;

   (c) the project is for the purpose of research;

   (d) I have been informed that the confidentiality of the information I provide will be safeguarded subject to any legal requirements;

   (e) I have been informed that with my consent the ***interview will be audio-taped and I understand that audio-tapes*** will be stored in secure place with the researcher and will be destroyed after five years;

(f) my name and the name of the institution I represent will be referred to by a pseudonym and the identity will be disguised in any publications arising from the research;

(g) I have been informed that a copy of the research findings will be forwarded to me, should I agree to this.

I consent to this ***interview*** being audio-taped ☐ **yes**

☐ **no**

(please tick)

I wish to receive a copy of the summary project report on research findings ☐ **yes**

☐ **no**

(please tick)

Participant signature: Date:

Appendix 5.3 The interview outline

Business School
Staffordshire University
Interview outline for persons participating in the research project

PROJECT TITLE:

Euroization and its impact on bank efficiency in transition economies: with special reference to South-East European countries

Abbreviations

FC – Foreign Currency
DC - Domestic Currency

Questions

1. Do you have FC loans or loans that are indexed to or linked in someway to FC (or Inflation)? If ***YES***, do you treat the linked loans as FC loans?and ***WHY***?

   ☐ **yes** ☐ **no**
   (please tick)

2. Does the bank have a strategy regarding FC loans and deposits? If ***NO***, then how does the bank deal with the FC loans and deposits? If ***YES,*** is this strategy established within the group/headquarter or within branch/subsidiary?

   ☐ **yes** ☐ **no**
   (please tick)

If within the group:

3. Is the FC strategy tailored to specific group member conditions? If ***YES***, how does your bank's strategy differ from the group's? If **NO,** does the negotiation process depend on your banks size within the group?

   ☐ **yes** ☐ **no**
   (please tick)

4. Does the group impose quotas or hard number limits for FC and FC linked lending? If, ***YES*** what are they and how often they change?

   ☐ **yes** ☐ **no**
   (please tick)

If within the bank:

5. How does your bank's strategy differ from the group's? Do you have entirely different procedures? Do you offer different conditions in comparison with the group? Do you have different limits in comparison with the group?

6. Why do you lend in FC? Do you lend in FC because you have FC deposits and want to hedge; or because FC loans are more profitable; or because there is a higher demand for FC loans?

   □ **Hedge, FC deposits**
   □ **FC loans, higher returns**
   □ **Demand for FC loans**
   (please tick and rank which is more important)

7. Do your banks' credit standards and conditions differ for FC loans/deposits versus DC loans/deposits? What about the FC linked loans/deposits to FC loans/deposits?and if ***YES***, for which category are there more favorable?

   □ **yes** □ **no**
   (please tick)

□ **FC loans more favorable**
□ **FC indexed more favorable**
□ **DC loans more favorable**
(please tick)

8. How is the favored category treated? Do you offer only lower interest rates for those loans or also have more relaxed credit standarts and conditions for them? Eg. require less colateral.

9. Can you tell us more regarding the performance of FC loans?Do they perform better than DC loans? What about FC linked loans, in comparison to FC loans or DC loans?

Appendix 5.4 The field note template

Business School
Staffordshire University
Field note

PROJECT TITLE:

Euroization and its impact on bank efficiency in transition economies: with special reference to South-East European countries

Background information

Date:

Name:

Position within the bank:

Impressions from the contact:

The main issues or themes that struck you in this contact:

Concerns:

Appendix 5.5 The complete list of themes and subthemes

g) FC Strategy
    i. Yes
        i. Where established and why?
            1. Within the group;
                a. Tailored to countries?
                    i. How different from your country?
            2. Same for every country?
                a. How much say you have in it?
            3. Does you group impose FC quotas or limits?
                a. Yes
                    i. What are they and how often they change?
                b. No
            4. Within the bank:
                a. How different from the group
                    i. Do you have FC quotas or limits
                        1. Yes
                            a. What are they and how often they change?
                        2. No
    ii. No
        i. How do you deal with FC loans
    iii. Factors influencing the FC strategy
        i. Business focus of the group vs bank
        ii. Size of the bank within the group
        iii. Previous experience with regard to FC risk
h) Instruments employed to address the FC risks
    iii. Limits
        i. Yes
            1. Set at the group
            2. Set at the bank
        ii. No
    iv. Credit standards and procedures
        i. Different treatment of FC loans
        ii. Currency mismatch

i) Drivers of FC lending:
    iv. Hedging
        i. FC deposits
    v. Higher returns
        i. Higher profit margin
        ii. Cheaper funding
    vi. Demand
        i. Currency stability
        ii. Higher return

j) FC indexed lending
    i. Yes
        i. Different treatment vs FC and DC?
            1. Which category is more favourable for the clients?
    ii. No

k) Performance of FC loans
    i. Yes
    ii. No

l) Encouragement of DC lending
    i. Yes
        i. Through base rate
        ii. Through reserve requirements on FC funds
        iii. Different RWA for FC assets
    ii. No

Appendix 6.1 Correlation matrix of MPIs

Correlation between the Macroprudential Policy Instruments

```
. cor FC_lim FCop_lim FC_LTV  FC_DTI FC_RR FC_RWA
(obs=175)

             |   FC_lim FCop_lim   FC_LTV   FC_DTI    FC_RR   FC_RWA
-------------+------------------------------------------------------
      FC_lim |   1.0000
    FCop_lim |   0.1432   1.0000
      FC_LTV |   0.1694  -0.2649   1.0000
      FC_DTI |   0.3165  -0.0778   0.5742   1.0000
       FC_RR |   0.1799   0.4015  -0.1929   0.0847   1.0000
      FC_RWA |   0.2614   0.1233   0.3032   0.2965   0.3511   1.0000
```

Appendix 6.2 Estimation of the 6.1 model and its long-run coefficients

Model 6.1 estimated through system GMM, whilst treating all independent variables exogenous

```
. xtabond2 Credit_FE lagCredit_FE Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI
FO  FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013,
gmm (lagCredit_FE, collapse lag (2 3)) iv (Deposit_FE IntRate_diff Inf_vol
ERR_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011
d_2012 d_2013) small two orthog robust
Favoring space over speed. To switch, type or click on mata: mata set matafavor
speed, perm.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: C_Id                            Number of obs      =       173
Time variable : Year                            Number of groups   =        25
Number of instruments = 20                      Obs per group: min =         6
F(17, 24)     =     43.28                                      avg =      6.92
Prob > F      =     0.000                                      max =         7
------------------------------------------------------------------------------
             |              Corrected
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagCredit_FE |   .4792535   .1902614     2.52   0.019      .0865732    .8719338
  Deposit_FE |    .286824   .1841474     1.56   0.132     -.0932375    .6668855
IntRate_diff |   .0057909   .0037283     1.55   0.133      -.001904    .0134857
     Inf_vol |   .0025608    .003934     0.65   0.521     -.0055585    .0106801
     ERR_vol |  -.6347735   .6382351    -0.99   0.330     -1.952026    .6824791
        BSRI |   .0248599   .0376291     0.66   0.515     -.0528028    .1025227
          FO |   .0696386   .0639344     1.09   0.287     -.0623156    .2015927
      FC_lim |  -.0293111   .0155477    -1.89   0.072        -.0614    .0027779
    FCop_lim |   .1108633   .0381106     2.91   0.008      .0322068    .1895197
      FC_LTV |    .106586   .0348172     3.06   0.005      .0347268    .1784453
      FC_RWA |   .0100658   .0199502     0.50   0.618     -.0311094     .051241
      d_2008 |  -.0043824   .0508325    -0.09   0.932     -.1092955    .1005307
```

```
      d_2009 |  -.0353655   .0583231    -0.61   0.550    -.1557383    .0850074
      d_2010 |  -.0272478   .0478384    -0.57   0.574    -.1259814    .0714858
      d_2011 |  -.0622388   .0786733    -0.79   0.437    -.2246126     .100135
      d_2012 |  -.0625347   .0634661    -0.99   0.334    -.1935222    .0684529
      d_2013 |  -.0538282   .0635053    -0.85   0.405    -.1848967    .0772402
       _cons |  -.0642763   .1674744    -0.38   0.705    -.4099265    .2813738
------------------------------------------------------------------------------
Instruments for orthogonal deviations equation
  Standard
    FOD.(Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim
    FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/3).lagCredit_FE collapsed
Instruments for levels equation
  Standard
    Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV
    FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.lagCredit_FE collapsed
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -1.15  Pr > z =  0.251
Arellano-Bond test for AR(2) in first differences: z =  -1.17  Pr > z =  0.242
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(2)    =   0.25  Prob > chi2 =  0.880
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(2)    =   0.62  Prob > chi2 =  0.733
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(1)    =   0.38  Prob > chi2 =  0.536
    Difference (null H = exogenous): chi2(1)    =   0.24  Prob > chi2 =  0.625
```

The long-run coefficients of 6.1

```
. nlcom _b[ Deposit_FE]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ Deposit_FE]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .5507939   .2231615     2.47   0.021     .0902111    1.011377
------------------------------------------------------------------------------

. nlcom _b[  IntRate_diff]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ IntRate_diff]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0111203   .0090551     1.23   0.231    -.0075684     .029809
------------------------------------------------------------------------------

. nlcom _b[  Inf_vol]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ Inf_vol]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
```

```
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0049176   .0082945     0.59   0.559    -.0122014    .0220365
------------------------------------------------------------------------------

. nlcom _b[  ERR_vol]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ ERR_vol]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -1.218968   1.003035    -1.22   0.236    -3.289131    .8511947
------------------------------------------------------------------------------

. nlcom _b[   BSRI]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ BSRI]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |    .047739   .0685864     0.70   0.493    -.0938163    .1892944
------------------------------------------------------------------------------

. nlcom _b[   FO]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FO]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .1337284    .116267     1.15   0.261     -.106235    .3736918
------------------------------------------------------------------------------

. nlcom _b[   FC_lim]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_lim]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -.0562867   .0296975    -1.90   0.070    -.1175794     .005006
------------------------------------------------------------------------------

. nlcom _b[  FCop_lim]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FCop_lim]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |    .212893   .0648269     3.28   0.003     .0790967    .3466892
------------------------------------------------------------------------------

. nlcom _b[   FC_LTV]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_LTV]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
       _nl_1 |   .2046793   .0499074     4.10   0.000     .1016754    .3076832
------------------------------------------------------------------------------

. nlcom _b[  FC_RWA]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_RWA]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0193296   .0368848     0.52   0.605    -.0567969    .0954561
------------------------------------------------------------------------------
```

Appendix 6.3 Estimation of the 6.2a model and its long-run coefficients

Model 6.2a estimated through system GMM, whilst treating exchange rate volatility as possibly endogenous and everything other independent variable exogenous

```
. xtabond2 Credit_FE lagCredit_FE Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI
FO  FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013,
gmm (lagCredit_FE, collapse lag (2 3)) gmm (ERR_vol , collapse lag (1 1)) iv
(Deposit_FE IntRate_diff Inf_vol BSRI FO FC_lim FCop_lim  FC_LTV FC_RWA d_2008
d_2009 d_2010 d_2011 d_2012 d_2013) small two orthog robust
Favoring space over speed. To switch, type or click on mata: mata set matafavor
speed, perm.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: C_Id                            Number of obs      =       173
Time variable : Year                            Number of groups   =        25
Number of instruments = 21                      Obs per group: min =         6
F(17, 24)     =     48.37                                      avg =      6.92
Prob > F      =     0.000                                      max =         7
------------------------------------------------------------------------------
             |              Corrected
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagCredit_FE |   .5245608   .1659174     3.16   0.004     .1821242    .8669975
  Deposit_FE |    .257628   .1666408     1.55   0.135    -.0863016    .6015576
IntRate_diff |    .005935   .0040217     1.48   0.153    -.0023653    .0142353
     Inf_vol |   .0025564   .0039777     0.64   0.527    -.0056532     .010766
     ERR_vol |  -1.146111   1.359853    -0.84   0.408    -3.952711    1.660488
        BSRI |   .0250342    .041801     0.60   0.555    -.0612389    .1113072
          FO |   .0586732   .0690228     0.85   0.404    -.0837829    .2011294
      FC_lim |  -.0280109   .0160048    -1.75   0.093    -.0610432    .0050213
    FCop_lim |   .1042617   .0396824     2.63   0.015     .0223613     .186162
      FC_LTV |   .0987738   .0359688     2.75   0.011     .0245379    .1730098
      FC_RWA |   .0063314   .0187725     0.34   0.739    -.0324131    .0450759
      d_2008 |    .002776   .0562806     0.05   0.961    -.1133814    .1189334
      d_2009 |   -.021826   .0619911    -0.35   0.728    -.1497693    .1061173
      d_2010 |  -.0226723   .0557334    -0.41   0.688    -.1377004    .0923557
      d_2011 |  -.0572753   .0899758    -0.64   0.530    -.2429762    .1284256
      d_2012 |  -.0568477    .074992    -0.76   0.456    -.2116236    .0979282
      d_2013 |  -.0468313   .0752046    -0.62   0.539     -.202046    .1083833
       _cons |  -.0654325   .1914566    -0.34   0.736    -.4605796    .3297145
------------------------------------------------------------------------------
Instruments for orthogonal deviations equation
  Standard
    FOD.(Deposit_FE IntRate_diff Inf_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA
    d_2008 d_2009 d_2010 d_2011 d_2012 d_2013)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.ERR_vol collapsed
    L(2/3).lagCredit_FE collapsed
Instruments for levels equation
  Standard
    Deposit_FE IntRate_diff Inf_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA
    d_2008 d_2009 d_2010 d_2011 d_2012 d_2013
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.ERR_vol collapsed
```

```
    DL.lagCredit_FE collapsed
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -1.30  Pr > z =  0.192
Arellano-Bond test for AR(2) in first differences: z =  -1.06  Pr > z =  0.289
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(3)    =   0.30  Prob > chi2 =  0.959
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(3)    =   1.17  Prob > chi2 =  0.760
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(1)    =   0.38  Prob > chi2 =  0.538
    Difference (null H = exogenous): chi2(2)    =   0.79  Prob > chi2 =  0.673
  gmm(lagCredit_FE, collapse lag(2 3))
    Hansen test excluding group:     chi2(0)    =   0.00  Prob > chi2 =      .
    Difference (null H = exogenous): chi2(3)    =   1.17  Prob > chi2 =  0.760
  gmm(ERR_vol, collapse lag(1 1))
    Hansen test excluding group:     chi2(1)    =   0.30  Prob > chi2 =  0.582
    Difference (null H = exogenous): chi2(2)    =   0.87  Prob > chi2 =  0.648
```

The long-run coefficients of 6.2a

```
. nlcom _b[ Deposit_FE]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ Deposit_FE]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .5418737    .252789     2.14   0.042      .020143    1.063604
------------------------------------------------------------------------------

. nlcom _b[  IntRate_diff]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ IntRate_diff]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0124833   .0098341     1.27   0.216    -.0078133    .0327798
------------------------------------------------------------------------------

. nlcom _b[  Inf_vol]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ Inf_vol]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0053769   .0090695     0.59   0.559    -.0133417    .0240956
------------------------------------------------------------------------------

. nlcom _b[  ERR_vol]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ ERR_vol]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -2.410637   2.697913    -0.89   0.380    -7.978857    3.157582
```

```
------------------------------------------------------------------------------

. nlcom _b[   BSRI]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ BSRI]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0526548   .0846363     0.62   0.540     -.122026    .2273356
------------------------------------------------------------------------------

. nlcom _b[   FO]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FO]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .1234085    .144235     0.86   0.401    -.1742779    .4210949
------------------------------------------------------------------------------

. nlcom _b[   FC_lim]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_lim]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -.0589159   .0344737    -1.71   0.100    -.1300661    .0122344
------------------------------------------------------------------------------

. nlcom _b[  FCop_lim]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FCop_lim]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .2192955   .0738947     2.97   0.007     .0667843    .3718066
------------------------------------------------------------------------------

. nlcom _b[   FC_LTV]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_LTV]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .2077529   .0617102     3.37   0.003     .0803893    .3351165
------------------------------------------------------------------------------

. nlcom _b[  FC_RWA]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_RWA]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |    .013317    .039872     0.33   0.741    -.0689747    .0956087
------------------------------------------------------------------------------
```

Appendix 6.4 Estimation of the 6.2b model and its long-run coefficients

Model 6.2b estimated through system GMM, whilst treating exchange rate volatility and macroprudential policy instruments as possibly endogenous and everything other independent variable exogenous

```
. xtabond2 Credit_FE lagCredit_FE Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI
FO  FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013,
gmm (lagCredit_FE, collapse lag (2 3)) gmm (ERR_vol FC_lim FCop_lim FC_LTV
FC_RWA , collapse lag (1 1)) iv (Deposit_FE IntRate_diff Inf_vol BSRI FO d_2008
d_2009 d_2010 d_2011 d_2012 d_2013) small two orthog robust
Favoring space over speed. To switch, type or click on mata: mata set matafavor
speed, perm.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: C_Id                            Number of obs      =       173
Time variable : Year                            Number of groups   =        25
Number of instruments = 25                      Obs per group: min =         6
F(17, 24)     =     25.51                                      avg =      6.92
Prob > F      =     0.000                                      max =         7
------------------------------------------------------------------------------
             |              Corrected
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagCredit_FE |   .4601041   .1772338     2.60   0.016     .0943114    .8258968
  Deposit_FE |   .0031739   .3557006     0.01   0.993     -.730956    .7373038
IntRate_diff |   .0075717   .0034622     2.19   0.039     .0004261    .0147172
     Inf_vol |   .0053937   .0044237     1.22   0.235    -.0037364    .0145238
     ERR_vol |   2.600202   2.158875     1.20   0.240    -1.855498    7.055902
        BSRI |  -.0088908   .0679064    -0.13   0.897    -.1490427    .1312611
          FO |   .1098001   .0822422     1.34   0.194    -.0599395    .2795397
      FC_lim |  -.0821037   .0383345    -2.14   0.043    -.1612222   -.0029852
    FCop_lim |   .1983008   .1897662     1.04   0.306    -.1933574     .589959
      FC_LTV |    .152666   .0563411     2.71   0.012     .0363836    .2689483
      FC_RWA |    .125445   .0348982     3.59   0.001     .0534187    .1974713
      d_2008 |  -.0190531   .0351839    -0.54   0.593    -.0916691    .0535629
      d_2009 |  -.0300318    .048598    -0.62   0.542    -.1303331    .0702695
      d_2010 |  -.0333685   .0376141    -0.89   0.384    -.1110003    .0442632
      d_2011 |  -.1235889   .0804973    -1.54   0.138    -.2897272    .0425494
      d_2012 |  -.1116603   .0680596    -1.64   0.114    -.2521284    .0288078
      d_2013 |  -.0994602   .0673886    -1.48   0.153    -.2385435     .039623
       _cons |   .0298807   .2555372     0.12   0.908    -.4975221    .5572835
------------------------------------------------------------------------------
Instruments for orthogonal deviations equation
  Standard
    FOD.(Deposit_FE IntRate_diff Inf_vol BSRI FO d_2008 d_2009 d_2010 d_2011
    d_2012 d_2013)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.(ERR_vol FC_lim FCop_lim FC_LTV FC_RWA) collapsed
    L(2/3).lagCredit_FE collapsed
Instruments for levels equation
  Standard
    Deposit_FE IntRate_diff Inf_vol BSRI FO d_2008 d_2009 d_2010 d_2011 d_2012
    d_2013
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
```

```
    D.(ERR_vol FC_lim FCop_lim FC_LTV FC_RWA) collapsed
    DL.lagCredit_FE collapsed
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -1.63  Pr > z =  0.103
Arellano-Bond test for AR(2) in first differences: z =  -1.19  Pr > z =  0.234
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(7)    =   2.54  Prob > chi2 =  0.924
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(7)    =   3.99  Prob > chi2 =  0.781
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(1)    =   0.30  Prob > chi2 =  0.583
    Difference (null H = exogenous): chi2(6)    =   3.69  Prob > chi2 =  0.719
  gmm(lagCredit_FE, collapse lag(2 3))
    Hansen test excluding group:     chi2(4)    =   2.45  Prob > chi2 =  0.653
    Difference (null H = exogenous): chi2(3)    =   1.53  Prob > chi2 =  0.674
```

Long-run coefficients 6.2b

```
. nlcom _b[ Deposit_FE]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ Deposit_FE]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0058787   .6579064     0.01   0.993    -1.351973    1.363731
------------------------------------------------------------------------------

. nlcom _b[  IntRate_diff]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ IntRate_diff]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0140243    .008356     1.68   0.106    -.0032216    .0312703
------------------------------------------------------------------------------

. nlcom _b[  Inf_vol]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ Inf_vol]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .0099903   .0098976     1.01   0.323    -.0104374    .0304179
------------------------------------------------------------------------------

. nlcom _b[  ERR_vol]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ ERR_vol]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   4.816117   4.579426     1.05   0.303    -4.635354    14.26759
------------------------------------------------------------------------------
```

```
. nlcom _b[   BSRI]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ BSRI]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -.0164676   .1283081    -0.13   0.899    -.2812826    .2483474
------------------------------------------------------------------------------

. nlcom _b[   FO]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FO]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .2033727   .1714857     1.19   0.247    -.1505563    .5573017
------------------------------------------------------------------------------

. nlcom _b[   FC_lim]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_lim]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -.1520732   .0752891    -2.02   0.055    -.3074623    .0033158
------------------------------------------------------------------------------

. nlcom _b[  FCop_lim]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FCop_lim]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .3672945   .3716134     0.99   0.333    -.3996778    1.134267
------------------------------------------------------------------------------

. nlcom _b[   FC_LTV]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_LTV]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .2827692   .1151435     2.46   0.022     .0451248    .5204137
------------------------------------------------------------------------------

. nlcom _b[  FC_RWA]/(1-_b[ lagCredit_FE])

       _nl_1:  _b[ FC_RWA]/(1-_b[ lagCredit_FE])

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   .2323504   .0979831     2.37   0.026     .0301232    .4345775
------------------------------------------------------------------------------
```

Appendix 6.5 The comparison of coefficients of 6.1 and 6.2a and 6.2b across FE, OLS System GMM estimators

The equivalent model estimated through system OLS and FE to check whether the size of the lagged dependent variable of models 6.1, 6.2a, and 6.2b models estimated through system GMM is within the range of the coefficient of lagged dependent variables of FE and OLS.

FE

```
. xtreg Credit_FE lagCredit_FE Deposit_FE  IntRate_diff Inf_vol ERR_vol BSRI FO
FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013, fe

Fixed-effects (within) regression               Number of obs      =       173
Group variable: C_Id                            Number of groups   =        25

R-sq:  within  = 0.3502                         Obs per group: min =         6
       between = 0.7052                                        avg =       6.9
       overall = 0.6076                                        max =         7

                                                F(17,131)          =      4.15
corr(u_i, Xb)  = 0.2516                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagCredit_FE |   .1843813   .0612466     3.01   0.003      .063221    .3055416
  Deposit_FE |   .0879813   .1396717     0.63   0.530    -.1883226    .3642852
IntRate_diff |   .0157463    .003489     4.51   0.000     .0088443    .0226484
     Inf_vol |   .0002659   .0032329     0.08   0.935    -.0061295    .0066613
     ERR_vol |   -.730784   2.272184    -0.32   0.748    -5.225707    3.764138
        BSRI |   .0199012   .0750573     0.27   0.791      -.12858    .1683824
          FO |   .0188696   .2129053     0.09   0.930    -.4023079    .4400471
      FC_lim |   .0154504   .0447319     0.35   0.730      -.07304    .1039409
    FCop_lim |   .1240368    .129032     0.96   0.338    -.1312192    .3792927
      FC_LTV |   .1341673   .0528955     2.54   0.012     .0295275    .2388072
      FC_RWA |    .034031   .0392266     0.87   0.387    -.0435686    .1116307
      d_2008 |   .0092605   .0347673     0.27   0.790    -.0595174    .0780385
      d_2009 |  -.0117896   .0343198    -0.34   0.732    -.0796824    .0561031
      d_2010 |  -.0212212   .0344615    -0.62   0.539    -.0893943    .0469519
      d_2011 |  -.0724875   .0410659    -1.77   0.080    -.1537257    .0087506
      d_2012 |  -.0791107    .041507    -1.91   0.059    -.1612214        .003
      d_2013 |  -.0697112    .042101    -1.66   0.100     -.152997    .0135746
       _cons |   .1495112   .2828361     0.53   0.598    -.4100062    .7090285
-------------+----------------------------------------------------------------
     sigma_u |  .11629892
     sigma_e |  .11205861
         rho |  .51856235   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(24, 131) =     2.80                 Prob > F = 0.0001
```

OLS

```
. regress Credit_FE lagCredit_FE Deposit_FE  IntRate_diff Inf_vol ERR_vol BSRI
FO FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013

      Source |       SS       df       MS              Number of obs =     173
-------------+------------------------------           F( 17,   155) =   25.94
       Model |  7.07787751    17  .416345736           Prob > F      =  0.0000
    Residual |  2.48781424   155  .016050414           R-squared     =  0.7399
-------------+------------------------------           Adj R-squared =  0.7114
       Total |  9.56569174   172  .055614487           Root MSE      =  .12669

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagCredit_FE |    .402561    .058532     6.88   0.000     .2869377    .5181843
  Deposit_FE |   .2853593   .0785042     3.63   0.000     .1302831    .4404354
IntRate_diff |   .0044336   .0027864     1.59   0.114    -.0010705    .0099378
     Inf_vol |   .0035366   .0031898     1.11   0.269    -.0027645    .0098378
     ERR_vol |   -.547023   1.168793    -0.47   0.640    -2.855842    1.761796
        BSRI |   .0096996   .0276816     0.35   0.727    -.0449823    .0643814
          FO |   .1110522    .047618     2.33   0.021     .0169882    .2051162
      FC_lim |  -.0321501   .0278688    -1.15   0.250    -.0872019    .0229016
    FCop_lim |   .1365355   .0319302     4.28   0.000      .073461    .1996101
      FC_LTV |   .1436272   .0305817     4.70   0.000     .0832165    .2040378
      FC_RWA |   .0086049   .0236614     0.36   0.717    -.0381355    .0553454
      d_2008 |    .014714   .0372097     0.40   0.693    -.0587896    .0882175
      d_2009 |  -.0182517   .0372537    -0.49   0.625    -.0918421    .0553387
      d_2010 |  -.0155117   .0373235    -0.42   0.678      -.08924    .0582167
      d_2011 |  -.0670194   .0386671    -1.73   0.085    -.1434019    .0093631
      d_2012 |  -.0639999   .0389796    -1.64   0.103    -.1409997    .0129999
      d_2013 |  -.0566902   .0397002    -1.43   0.155    -.1351134    .0217331
       _cons |  -.0366779    .094105    -0.39   0.697    -.2225717     .149216
------------------------------------------------------------------------------
```

Appendix 6.6 Instability of the model in relation to instrumentation

```
. xtabond2   D_Credit_FE   lagD_Credit_E  D_Deposit_FE IntRate_diff Inf_vol
ERR_vol BSRI FO  FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011
d_2012 d_2013, gmm (lagCredit_FE, collapse lag (2 3)) iv (D_Deposit_FE
IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA d_2008
d_2009 d_2010 d_2011 d_2012 d_2013) small two orthog robust
Favoring space over speed. To switch, type or click on mata: mata set matafavor
speed, perm.
d_2008 dropped due to collinearity
d_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-
step estimation.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: C_Id                            Number of obs      =       124
Time variable : Year                            Number of groups   =        25
Number of instruments = 18                      Obs per group: min =         4
F(15, 24)     =     47.65                                      avg =      4.96
Prob > F      =     0.000                                      max =         5
------------------------------------------------------------------------------
             |              Corrected
  D_Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagD_Credit_E |    .519055   .2164729     2.40   0.025     .0722769     .965833
 D_Deposit_FE |  -.1578004   .9474763    -0.17   0.869    -2.113295    1.797694
 IntRate_diff |  -.0026207   .0021126    -1.24   0.227    -.0069808    .0017394
      Inf_vol |   .0046657   .0029359     1.59   0.125    -.0013937    .0107252
      ERR_vol |  -.8039395   1.374718    -0.58   0.564    -3.641219     2.03334
         BSRI |  -.0061028    .017784    -0.34   0.734     -.042807    .0306015
           FO |  -.0051836    .018759    -0.28   0.785    -.0439003     .033533
       FC_lim |   .0111768   .0111938     1.00   0.328     -.011926    .0342796
     FCop_lim |   .0013146    .015538     0.08   0.933    -.0307542    .0333835
       FC_LTV |   .0115354    .012394     0.93   0.361    -.0140444    .0371153
       FC_RWA |  -.0116014   .0207027    -0.56   0.580    -.0543297    .0311269
       d_2010 |   .0279394   .0687037     0.41   0.688     -.113858    .1697368
       d_2011 |    .000962   .0850883     0.01   0.991    -.1746515    .1765755
       d_2012 |   .0170426   .0380847     0.45   0.659    -.0615603    .0956455
       d_2013 |   .0231387   .0515768     0.45   0.658    -.0833106     .129588
        _cons |  -.0001272   .0864123    -0.00   0.999    -.1784734    .1782191
------------------------------------------------------------------------------
Instruments for orthogonal deviations equation
  Standard
    FOD.(D_Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim
    FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/3).lagCredit_FE collapsed
Instruments for levels equation
  Standard
    D_Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV
    FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.lagCredit_FE collapsed
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -1.32  Pr > z =  0.186
```

```
Arellano-Bond test for AR(2) in first differences: z =   1.11  Pr > z =  0.268
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(2)    =   0.17  Prob > chi2 =  0.919
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(2)    =   0.87  Prob > chi2 =  0.648
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(1)    =   0.02  Prob > chi2 =  0.882
    Difference (null H = exogenous): chi2(1)    =   0.85  Prob > chi2 =  0.358


. xtabond2   D_Credit_FE   lagD_Credit_E  D_Deposit_FE IntRate_diff Inf_vol
ERR_vol BSRI FO  FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011
d_2012 d_2013, gmm (lagCredit_FE, collapse lag (2 2)) iv (D_Deposit_FE
IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA d_2008
d_2009 d_2010 d_2011 d_2012 d_2013) small two orthog robust
Favoring space over speed. To switch, type or click on mata: mata set matafavor
speed, perm.
d_2008 dropped due to collinearity
d_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-
step estimation.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: C_Id                            Number of obs      =       124
Time variable : Year                            Number of groups   =        25
Number of instruments = 17                      Obs per group: min =         4
F(15, 24)     =     79.46                                      avg =      4.96
Prob > F      =     0.000                                      max =         5
------------------------------------------------------------------------------
             |              Corrected
  D_Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagD_Credit_E |   .8481298   .3950913     2.15   0.042     .0327015    1.663558
 D_Deposit_FE |  -.5074678   .9283867    -0.55   0.590    -2.423564    1.408628
 IntRate_diff |  -.0052978    .004015    -1.32   0.199    -.0135843    .0029888
      Inf_vol |   .0057967   .0031766     1.82   0.081    -.0007596    .0123529
      ERR_vol |  -.9200313   1.374858    -0.67   0.510    -3.757598    1.917535
         BSRI |  -.0057018   .0179676    -0.32   0.754    -.0427851    .0313816
           FO |   .0003105   .0220088     0.01   0.989    -.0451134    .0457344
       FC_lim |   .0056757   .0159599     0.36   0.725    -.0272639    .0386152
     FCop_lim |   .0117392   .0220354     0.53   0.599    -.0337396     .057218
       FC_LTV |    .011023   .0135182     0.82   0.423    -.0168772    .0389232
       FC_RWA |   -.016962   .0246381    -0.69   0.498    -.0678125    .0338885
       d_2010 |   .0340827   .0660311     0.52   0.610    -.1021989    .1703643
       d_2011 |  -.0088187   .0788656    -0.11   0.912    -.1715893    .1539518
       d_2012 |   .0348933   .0380487     0.92   0.368    -.0436353    .1134219
       d_2013 |   .0251085   .0482894     0.52   0.608    -.0745559    .1247728
        _cons |  -.0009414   .0829687    -0.01   0.991    -.1721803    .1702976
------------------------------------------------------------------------------
Instruments for orthogonal deviations equation
  Standard
    FOD.(D_Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim
    FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L2.lagCredit_FE collapsed
```

```
Instruments for levels equation
  Standard
    D_Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV
    FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.lagCredit_FE collapsed
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -1.31  Pr > z =  0.191
Arellano-Bond test for AR(2) in first differences: z =   1.09  Pr > z =  0.278
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(1)    =   0.04  Prob > chi2 =  0.833
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(1)    =   0.14  Prob > chi2 =  0.712
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(0)    =   0.00  Prob > chi2 =      .
    Difference (null H = exogenous): chi2(1)    =   0.14  Prob > chi2 =  0.712


. xtabond2   D_Credit_FE   lagD_Credit_E  D_Deposit_FE IntRate_diff Inf_vol
ERR_vol BSRI FO  FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011
d_2012 d_2013, gmm (lagCredit_FE, collapse lag (2 .)) iv (D_Deposit_FE
IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA d_2008
d_2009 d_2010 d_2011 d_2012 d_2013) small two orthog robust
Favoring space over speed. To switch, type or click on mata: mata set matafavor
speed, perm.
d_2008 dropped due to collinearity
d_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-
step estimation.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: C_Id                            Number of obs      =       124
Time variable : Year                            Number of groups   =        25
Number of instruments = 21                      Obs per group: min =         4
F(15, 24)     =     22.00                                      avg =      4.96
Prob > F      =     0.000                                      max =         5
------------------------------------------------------------------------------
             |               Corrected
  D_Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagD_Credit_E |    .105283    .326244     0.32   0.750    -.5680515    .7786174
 D_Deposit_FE |   .1956431   .3917312     0.50   0.622    -.6128504    1.004137
 IntRate_diff |  -.0001221   .0021246    -0.06   0.955    -.0045072    .0042629
      Inf_vol |   .0037989    .001662     2.29   0.031     .0003686    .0072291
      ERR_vol |  -.3955535   .6432364    -0.61   0.544    -1.723128    .9320212
         BSRI |   .0115826   .0174369     0.66   0.513    -.0244055    .0475707
           FO |  -.0115928   .0192485    -0.60   0.553    -.0513198    .0281342
       FC_lim |   .0084232   .0117119     0.72   0.479    -.0157489    .0325953
     FCop_lim |   -.000958   .0149756    -0.06   0.950    -.0318662    .0299501
       FC_LTV |   .0039293    .011395     0.34   0.733    -.0195889    .0274475
       FC_RWA |   .0006515   .0162732     0.04   0.968    -.0329347    .0342377
       d_2010 |   .0334663   .0408275     0.82   0.420    -.0507976    .1177302
       d_2011 |   .0283653   .0362656     0.78   0.442    -.0464833     .103214
       d_2012 |   .0169685   .0306738     0.55   0.585    -.0463391    .0802761
```

```
       d_2013 |     .02984   .0286557     1.04   0.308    -.0293025    .0889825
        _cons |  -.0696809   .0574825    -1.21   0.237    -.1883188    .0489571
------------------------------------------------------------------------------
Instruments for orthogonal deviations equation
  Standard
    FOD.(D_Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim
    FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/6).lagCredit_FE collapsed
Instruments for levels equation
  Standard
    D_Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV
    FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.lagCredit_FE collapsed
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -0.93  Pr > z =  0.355
Arellano-Bond test for AR(2) in first differences: z =   0.33  Pr > z =  0.742
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(5)    =   4.64  Prob > chi2 =  0.462
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(5)    =   2.80  Prob > chi2 =  0.731
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(4)    =   2.71  Prob > chi2 =  0.607
    Difference (null H = exogenous): chi2(1)    =   0.09  Prob > chi2 =  0.769


. xtabond2   D_Credit_FE   lagD_Credit_E  D_Deposit_FE IntRate_diff Inf_vol
ERR_vol BSRI FO  FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011
d_2012 d_2013, gmm (lagCredit_FE, collapse lag (1 .)) iv (D_Deposit_FE
IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA d_2008
d_2009 d_2010 d_2011 d_2012 d_2013) small two orthog robust
Favoring space over speed. To switch, type or click on mata: mata set matafavor
speed, perm.
d_2008 dropped due to collinearity
d_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-
step estimation.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: C_Id                            Number of obs      =       124
Time variable : Year                            Number of groups   =        25
Number of instruments = 22                      Obs per group: min =         4
F(15, 24)     =     26.34                                      avg =      4.96
Prob > F      =     0.000                                      max =         5
------------------------------------------------------------------------------
             |              Corrected
  D_Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagD_Credit_E |  -.0479317   .0664076    -0.72   0.477    -.1849904    .0891269
 D_Deposit_FE |   .2223371   .4042399     0.55   0.587    -.6119731    1.056647
 IntRate_diff |   .0003745   .0016392     0.23   0.821    -.0030086    .0037577
      Inf_vol |    .003735   .0014432     2.59   0.016     .0007564    .0067135
      ERR_vol |   -.334347   .6722895    -0.50   0.623    -1.721884     1.05319
```

```
        BSRI |   .0116192   .0208475     0.56   0.582     -.031408    .0546464
          FO |  -.0144024   .0232731    -0.62   0.542    -.0624358     .033631
      FC_lim |   .0055691   .0136559     0.41   0.687    -.0226153    .0337536
   FCop_lim |  -.0034228   .0170579    -0.20   0.843    -.0386286     .031783
     FC_LTV |   .0053652   .0122233     0.44   0.665    -.0198624    .0305929
     FC_RWA |   .0050257    .014805     0.34   0.737    -.0255303    .0355816
     d_2010 |   .0334577   .0322456     1.04   0.310     -.033094    .1000093
     d_2011 |   .0300043   .0335568     0.89   0.380    -.0392536    .0992622
     d_2012 |    .021329   .0264097     0.81   0.427     -.033178    .0758361
     d_2013 |   .0298142   .0252798     1.18   0.250    -.0223607    .0819891
      _cons |  -.0738275   .0728537    -1.01   0.321    -.2241901    .0765351
------------------------------------------------------------------------------
Instruments for orthogonal deviations equation
  Standard
    FOD.(D_Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim
    FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(1/6).lagCredit_FE collapsed
Instruments for levels equation
  Standard
    D_Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV
    FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.lagCredit_FE collapsed
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -1.09  Pr > z =  0.274
Arellano-Bond test for AR(2) in first differences: z =  -0.75  Pr > z =  0.455
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(6)    =   4.59  Prob > chi2 =  0.598
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(6)    =   3.51  Prob > chi2 =  0.743
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(5)    =   2.93  Prob > chi2 =  0.711
    Difference (null H = exogenous): chi2(1)    =   0.58  Prob > chi2 =  0.446
```

Appendix 6.7 Comparison of coefficients across FE, OLS System GMM

A version of the Model 6.1 estimated through FE and RE, and the Hausman test results

FE

```
. xtreg Credit_FE Deposit_FE IntRate_diff Inf_vol ERR_vol FO BSRI FC_lim
FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013, fe

Fixed-effects (within) regression               Number of obs      =       174
Group variable: C_Id                            Number of groups   =        25

R-sq:  within  = 0.3054                         Obs per group: min =         6
       between = 0.5454                                        avg =       7.0
       overall = 0.4835                                        max =         7
```

```
                                                F(16,133)         =      3.65
corr(u_i, Xb)  = 0.0720                         Prob > F          =    0.0000

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  Deposit_FE |    .127602   .1427249     0.89   0.373    -.1547024    .4099064
IntRate_diff |   .0185071   .0034561     5.35   0.000     .0116711    .0253431
     Inf_vol |  -.0018021    .003243    -0.56   0.579    -.0082166    .0046124
     ERR_vol |  -.8299774   2.331948    -0.36   0.722     -5.44248    3.782525
          FO |   .0073461   .2183239     0.03   0.973      -.42449    .4391822
        BSRI |  -.0107178   .0750116    -0.14   0.887    -.1590879    .1376523
      FC_lim |   .0217767   .0455451     0.48   0.633    -.0683097     .111863
    FCop_lim |   .1491293   .1321932     1.13   0.261    -.1123437    .4106022
      FC_LTV |   .1658583   .0532239     3.12   0.002     .0605835    .2711332
      FC_RWA |   .0424027   .0397957     1.07   0.289    -.0363116    .1211171
      d_2008 |   .0098514    .035439     0.28   0.781    -.0602456    .0799484
      d_2009 |  -.0118638   .0349764    -0.34   0.735    -.0810457    .0573181
      d_2010 |  -.0245868   .0351705    -0.70   0.486    -.0941526     .044979
      d_2011 |  -.0891003   .0412758    -2.16   0.033    -.1707423   -.0074583
      d_2012 |  -.1027848   .0414328    -2.48   0.014    -.1847373   -.0208324
      d_2013 |  -.0961331   .0419123    -2.29   0.023    -.1790341   -.0132321
       _cons |   .3028431    .282365     1.07   0.285    -.2556639      .86135
-------------+----------------------------------------------------------------
     sigma_u |   .1390332
     sigma_e |  .11504529
         rho |   .5935773   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(24, 133) =     4.70             Prob > F = 0.0000

. estimates store FE_feb
```

RE

```
. xtreg Credit_FE Deposit_FE IntRate_diff Inf_vol ERR_vol FO BSRI FC_lim
FCop_lim FC_LTV FC_R
> WA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013, re

Random-effects GLS regression                   Number of obs      =       174
Group variable: C_Id                            Number of groups   =        25

R-sq:  within  = 0.2797                         Obs per group: min =         6
       between = 0.7590                                        avg =       7.0
       overall = 0.6321                                        max =         7

                                                Wald chi2(16)      =    122.87
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  Deposit_FE |   .2850068   .1076446     2.65   0.008     .0740273    .4959862
IntRate_diff |   .0143879   .0031509     4.57   0.000     .0082123    .0205635
     Inf_vol |  -.0018635   .0031449    -0.59   0.553    -.0080275    .0043005
     ERR_vol |  -.8357728   1.774854    -0.47   0.638    -4.314423    2.642877
          FO |   .1663633   .0834051     1.99   0.046     .0028924    .3298343
        BSRI |   .0077593   .0419094     0.19   0.853    -.0743816    .0899003
      FC_lim |   -.021065   .0375164    -0.56   0.574    -.0945957    .0524657
```

```
    FCop_lim |   .2099435   .0538622     3.90   0.000     .1043756    .3155115
      FC_LTV |     .18085   .0406047     4.45   0.000     .1012663    .2604337
      FC_RWA |    .025431   .0307472     0.83   0.408    -.0348323    .0856944
      d_2008 |   .0123282   .0344512     0.36   0.720    -.0551948    .0798512
      d_2009 |  -.0188029   .0345646    -0.54   0.586    -.0865484    .0489425
      d_2010 |  -.0219091   .0347506    -0.63   0.528     -.090019    .0462009
      d_2011 |  -.0767437    .037494    -2.05   0.041    -.1502305   -.0032569
      d_2012 |  -.0893823   .0378229    -2.36   0.018    -.1635139   -.0152507
      d_2013 |   -.085631   .0385563    -2.22   0.026       -.1612    -.010062
       _cons |   .0566816   .1398051     0.41   0.685    -.2173314    .3306947
-------------+----------------------------------------------------------------
     sigma_u |  .09324174
     sigma_e |  .11504529
         rho |  .39645436   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. estimates store RE_feb
```

Hausman Test

```
. hausman FE_feb RE_feb

                 ---- Coefficients ----
              |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
              |     FE_feb       RE_feb       Difference          S.E.
--------------+----------------------------------------------------------------
  Deposit_FE |     .127602     .2850068       -.1574048         .093718
IntRate_diff |    .0185071     .0143879        .0041192        .0014201
     Inf_vol |   -.0018021    -.0018635        .0000614        .0007913
     ERR_vol |   -.8299774    -.8357728        .0057954        1.512572
          FO |    .0073461     .1663633       -.1590172        .2017645
        BSRI |   -.0107178     .0077593       -.0184771        .0622121
      FC_lim |    .0217767     -.021065        .0428417        .0258239
    FCop_lim |    .1491293     .2099435       -.0608142        .1207224
      FC_LTV |    .1658583       .18085       -.0149917        .0344099
      FC_RWA |    .0424027      .025431        .0169717        .0252648
      d_2008 |    .0098514     .0123282       -.0024768        .0083091
      d_2009 |   -.0118638    -.0188029        .0069391        .0053509
      d_2010 |   -.0245868    -.0219091       -.0026777        .0054182
      d_2011 |   -.0891003    -.0767437       -.0123566        .0172597
      d_2012 |   -.1027848    -.0893823       -.0134026        .0169145
      d_2013 |   -.0961331     -.085631       -.0105021        .0164334
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(16) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       19.50
                Prob>chi2 =      0.2438
                (V_b-V_B is not positive definite)
```

Appendix 6.8 Testing for CFR for FE and RE

Testing for the CFR individually and jointly for model 6.10 estimated through FE and RE

Testing for RE

```
. xtreg Credit_FE lagCredit_FE Deposit_FE  lag_Deposit_FE IntRate_diff
lagintrate_diff Inf_vol  laginf_vol ERR_vol  lagerr_vol BSRI  lagb
> sri FO  lagfo  FC_lim  lagfc_lim FCop_lim  lagfcop_lim FC_LTV  laglfc_ltv
FC_RWA  lagfc_rwa d_2008 d_2009 d_2010 d_2011 d_2012 d_2013,  re

Random-effects GLS regression                   Number of obs      =       172
Group variable: C_Id                            Number of groups   =        25

R-sq:  within  = 0.3816                         Obs per group: min =         5
       between = 0.9623                                        avg =       6.9
       overall = 0.7971                                        max =         7

                                                Wald chi2(27)      =    565.66
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      Credit_FE |      Coef.   Std. Err.      z    P>|z|     [95% Conf.
Interval]
----------------+-------------------------------------------------------------
   lagCredit_FE |   .6350524   .0663864     9.57   0.000     .5049376  .7651673
     Deposit_FE |   .4533634   .1122596     4.04   0.000     .2333386  .6733882
 lag_Deposit_FE |  -.3160258   .1162645    -2.72   0.007    -.5439001 -.0881515
   IntRate_diff |   .0053323   .0035838     1.49   0.137    -.0016917  .0123563
lagintrate_diff |  -.0021523   .0033143    -0.65   0.516    -.0086482  .0043437
        Inf_vol |   .0041035   .0031043     1.32   0.186    -.0019809  .0101878
     laginf_vol |  -.0017727   .0032618    -0.54   0.587    -.0081658  .0046203
        ERR_vol |   -.931358   1.686806    -0.55   0.581    -4.237438  2.374722
     lagerr_vol |   1.346795   1.684772     0.80   0.424    -1.955298  4.648888
           BSRI |  -.0468623   .0407244    -1.15   0.250    -.1266806  .0329561
        lagbsri |   .0515914   .0401167     1.29   0.198     -.027036  .1302187
             FO |   .1563947   .0690093     2.27   0.023      .021139  .2916505
          lagfo |  -.0765311   .0700612    -1.09   0.275    -.2138485  .0607863
         FC_lim |   .0064174   .0386752     0.17   0.868    -.0693847  .0822195
      lagfc_lim |  -.0343016   .0384746    -0.89   0.373    -.1097104  .0411072
       FCop_lim |    .158762   .0495189     3.21   0.001     .0617067  .2558173
    lagfcop_lim |  -.0889205   .0484237    -1.84   0.066    -.1838291  .0059882
         FC_LTV |   .1588927    .041238     3.85   0.000     .0780676  .2397177
     laglfc_ltv |  -.0747295   .0429038    -1.74   0.082    -.1588194  .0093603
         FC_RWA |   .0238973   .0338732     0.71   0.481    -.0424929  .0902874
      lagfc_rwa |  -.0262419   .0330919    -0.79   0.428     -.091101  .0386171
        d_2008 |  -.0532326   .0394315    -1.35   0.177    -.1305169  .0240517
        d_2009 |  -.1037729    .040551    -2.56   0.010    -.1832514 -.0242944
        d_2010 |  -.0771066   .0409432    -1.88   0.060    -.1573538  .0031406
        d_2011 |  -.1490116   .0445791    -3.34   0.001     -.236385 -.0616382
        d_2012 |  -.1082026   .0391966    -2.76   0.006    -.1850264 -.0313787
        d_2013 |  -.0941132   .0394762    -2.38   0.017    -.1714852 -.0167412
         _cons |   .0650288   .0925738     0.70   0.482    -.116412   .24647
----------------+-------------------------------------------------------------
       sigma_u |          0
       sigma_e |  .10790028
           rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
. . testnl (_b[lagCredit_FE]*_b[Deposit_FE]=-_b[lag_Deposit_FE])

  (1)  _b[lagCredit_FE]*_b[Deposit_FE] = -_b[lag_Deposit_FE]

              chi2(1) =        0.15
          Prob > chi2 =        0.7012

. . testnl (_b[lagCredit_FE]*_b[ IntRate_diff]=-_b[ lagintrate_diff])

  (1)  _b[lagCredit_FE]*_b[ IntRate_diff] = -_b[ lagintrate_diff]

              chi2(1) =        0.21
          Prob > chi2 =        0.6478

. . testnl (_b[lagCredit_FE]*_b[  Inf_vol]=-_b[ laginf_vol])

  (1)  _b[lagCredit_FE]*_b[  Inf_vol] = -_b[ laginf_vol]

              chi2(1) =        0.06
          Prob > chi2 =        0.8076

. . testnl (_b[lagCredit_FE]*_b[  ERR_vol]=-_b[  lagerr_vol])

  (1)  _b[lagCredit_FE]*_b[  ERR_vol] = -_b[  lagerr_vol]

              chi2(1) =        0.46
          Prob > chi2 =        0.4984

. . testnl (_b[lagCredit_FE]*_b[  BSRI]=-_b[  lagbsri])

  (1)  _b[lagCredit_FE]*_b[  BSRI] = -_b[  lagbsri]

              chi2(1) =        0.67
          Prob > chi2 =        0.4126

. . testnl (_b[lagCredit_FE]*_b[ FO]=-_b[   lagfo])

  (1)  _b[lagCredit_FE]*_b[ FO] = -_b[   lagfo]

              chi2(1) =        0.26
          Prob > chi2 =        0.6123

. . testnl (_b[lagCredit_FE]*_b[  FC_lim]=-_b[   lagfc_lim])

  (1)  _b[lagCredit_FE]*_b[  FC_lim] = -_b[   lagfc_lim]

              chi2(1) =        1.28
          Prob > chi2 =        0.2576

. . testnl (_b[lagCredit_FE]*_b[   FCop_lim]=-_b[   lagfcop_lim])

  (1)  _b[lagCredit_FE]*_b[   FCop_lim] = -_b[   lagfcop_lim]

              chi2(1) =        0.16
          Prob > chi2 =        0.6851

. . testnl (_b[lagCredit_FE]*_b[  FC_LTV]=-_b[  laglfc_ltv])

  (1)  _b[lagCredit_FE]*_b[  FC_LTV] = -_b[  laglfc_ltv]
```

```
             chi2(1) =        0.92
           Prob > chi2 =        0.3381

. . testnl (_b[lagCredit_FE]*_b[  FC_RWA]=-_b[  lagfc_rwa])

  (1)  _b[lagCredit_FE]*_b[  FC_RWA] = -_b[  lagfc_rwa]

             chi2(1) =        0.25
           Prob > chi2 =        0.6189

. . testnl (_b[lagCredit_FE]*_b[Deposit_FE]=-_b[lag_Deposit_FE])
(_b[lagCredit_FE]*_b[ IntRate_diff]=-_b[ lagintrate_diff]) (_b[lagCredit
> _FE]*_b[  Inf_vol]=-_b[ laginf_vol]) (_b[lagCredit_FE]*_b[  ERR_vol]=-_b[
lagerr_vol]) (_b[lagCredit_FE]*_b[  BSRI]=-_b[  lagbsri]) (_
> b[lagCredit_FE]*_b[ FO]=-_b[   lagfo]) (_b[lagCredit_FE]*_b[  FC_lim]=-_b[
lagfc_lim]) (_b[lagCredit_FE]*_b[   FCop_lim]=-_b[   lagfc
> op_lim]) (_b[lagCredit_FE]*_b[  FC_LTV]=-_b[  laglfc_ltv])
(_b[lagCredit_FE]*_b[  FC_RWA]=-_b[  lagfc_rwa])

  (1)  _b[lagCredit_FE]*_b[Deposit_FE] = -_b[lag_Deposit_FE]
  (2)  _b[lagCredit_FE]*_b[ IntRate_diff] = -_b[ lagintrate_diff]
  (3)  _b[lagCredit_FE]*_b[  Inf_vol] = -_b[ laginf_vol]
  (4)  _b[lagCredit_FE]*_b[  ERR_vol] = -_b[  lagerr_vol]
  (5)  _b[lagCredit_FE]*_b[  BSRI] = -_b[  lagbsri]
  (6)  _b[lagCredit_FE]*_b[ FO] = -_b[   lagfo]
  (7)  _b[lagCredit_FE]*_b[  FC_lim] = -_b[   lagfc_lim]
  (8)  _b[lagCredit_FE]*_b[   FCop_lim] = -_b[   lagfcop_lim]
  (9)  _b[lagCredit_FE]*_b[  FC_LTV] = -_b[  laglfc_ltv]
  (10) _b[lagCredit_FE]*_b[  FC_RWA] = -_b[  lagfc_rwa]

            chi2(10) =        5.52
           Prob > chi2 =        0.8538
```

Testing for FE

```
. xtreg Credit_FE lagCredit_FE Deposit_FE  lag_Deposit_FE IntRate_diff
lagintrate_diff Inf_vol  laginf_vol ERR_vol  lagerr_vol BSRI  lag bsri FO
lagfo  FC_lim  lagfc_lim FCop_lim  lagfcop_lim FC_LTV  laglfc_ltv FC_RWA
lagfc_rwa d_2008 d_2009 d_2010 d_2011 d_2012 d_2013, fe

Fixed-effects (within) regression               Number of obs      =       172
Group variable: C_Id                            Number of groups   =        25

R-sq:  within  = 0.4474                         Obs per group: min =         5
       between = 0.7458                                        avg =       6.9
       overall = 0.6656                                        max =         7

                                                F(27,120)          =      3.60
corr(u_i, Xb)  = 0.1784                         Prob > F           =    0.0000

------------------------------------------------------------------------------
      Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
----------------+-------------------------------------------------------------
   lagCredit_FE |   .3448775   .0820306     4.20   0.000     .1824626  .5072923
     Deposit_FE |   .3194393   .1560857     2.05   0.043     .0104005  .6284781
 lag_Deposit_FE |  -.3136861   .1223233    -2.56   0.012    -.5558776 -.0714945
   IntRate_diff |   .0156599   .0045802     3.42   0.001     .0065913  .0247284
lagintrate_diff |   .0018757   .0034327     0.55   0.586    -.0049208  .0086722
        Inf_vol |   .0018996   .0032734     0.58   0.563    -.0045816  .0083808
     laginf_vol |   -.004158   .0035793    -1.16   0.248    -.0112447  .0029287
```

```
       ERR_vol |  -.3961471   2.325998    -0.17   0.865    -5.001461  4.209167
     lagerr_vol |  -.1930605   1.779515    -0.11   0.914    -3.716377  3.330256
           BSRI |   .0054661   .0758492     0.07   0.943      -.14471  .1556422
        lagbsri |   .0367154   .0422016     0.87   0.386    -.0468409  .1202717
             FO |   .0411481   .2107636     0.20   0.846    -.3761492  .4584453
          lagfo |   -.077805   .0736804    -1.06   0.293    -.2236871  .068077
         FC_lim |   .0251417   .0477877     0.53   0.600    -.0694746  .1197581
       lagfc_lim |  -.0118048   .0405045    -0.29   0.771    -.0920009  .0683913
        FCop_lim |   .1241975   .1300899     0.95   0.342    -.1333714  .3817665
    lagfcop_lim |   .0009626   .0583387     0.02   0.987    -.1145439  .1164692
         FC_LTV |   .1180447   .0568005     2.08   0.040     .0055836  .2305058
      laglfc_ltv |  -.0055718   .0474615    -0.12   0.907    -.0995424  .0883987
         FC_RWA |   .0278233   .0421163     0.66   0.510    -.0555641  .1112107
       lagfc_rwa |   .0012002   .0349928     0.03   0.973    -.0680831  .0704836
          d_2008 |  -.0279816   .0387445    -0.72   0.472    -.1046931  .0487299
          d_2009 |  -.0577795    .040508    -1.43   0.156    -.1379826  .0224236
          d_2010 |  -.0417203   .0400595    -1.04   0.300    -.1210353  .0375947
          d_2011 |  -.1068898   .0459628    -2.33   0.022     -.197893 -.0158866
          d_2012 |  -.0898963   .0425274    -2.11   0.037    -.1740976  -.005695
          d_2013 |  -.0775624   .0426841    -1.82   0.072    -.1620739  .0069491
           _cons |   .0990528   .3018866     0.33   0.743    -.4986617  .6967672
-----------------+------------------------------------------------------------
         sigma_u |  .10559419
         sigma_e |  .10790028
             rho |  .48919963   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(24, 120) =     1.92                 Prob > F = 0.0115

. . testnl (_b[lagCredit_FE]*_b[Deposit_FE]=-_b[lag_Deposit_FE])

  (1)  _b[lagCredit_FE]*_b[Deposit_FE] = -_b[lag_Deposit_FE]

             F(1, 120) =        3.47
              Prob > F =        0.0650

. . testnl (_b[lagCredit_FE]*_b[ IntRate_diff]=-_b[ lagintrate_diff])

  (1)  _b[lagCredit_FE]*_b[ IntRate_diff] = -_b[ lagintrate_diff]

             F(1, 120) =        5.41
              Prob > F =        0.0217

. . testnl (_b[lagCredit_FE]*_b[  Inf_vol]=-_b[ laginf_vol])

  (1)  _b[lagCredit_FE]*_b[  Inf_vol] = -_b[ laginf_vol]

             F(1, 120) =        0.85
              Prob > F =        0.3583

. . testnl (_b[lagCredit_FE]*_b[  ERR_vol]=-_b[  lagerr_vol])

  (1)  _b[lagCredit_FE]*_b[  ERR_vol] = -_b[  lagerr_vol]

             F(1, 120) =        0.03
              Prob > F =        0.8575

. . testnl (_b[lagCredit_FE]*_b[  BSRI]=-_b[  lagbsri])

  (1)  _b[lagCredit_FE]*_b[  BSRI] = -_b[  lagbsri]

             F(1, 120) =        0.67
```

```
             Prob > F =        0.4160

. . testnl (_b[lagCredit_FE]*_b[ FO]=-_b[   lagfo])

  (1)  _b[lagCredit_FE]*_b[ FO] = -_b[   lagfo]

           F(1, 120) =        0.40
            Prob > F =        0.5295

. . testnl (_b[lagCredit_FE]*_b[  FC_lim]=-_b[   lagfc_lim])

  (1)  _b[lagCredit_FE]*_b[  FC_lim] = -_b[   lagfc_lim]

           F(1, 120) =        0.01
            Prob > F =        0.9350

. . testnl (_b[lagCredit_FE]*_b[   FCop_lim]=-_b[   lagfcop_lim])

  (1)  _b[lagCredit_FE]*_b[   FCop_lim] = -_b[   lagfcop_lim]

           F(1, 120) =        0.32
            Prob > F =        0.5753

. . testnl (_b[lagCredit_FE]*_b[  FC_LTV]=-_b[  laglfc_ltv])

  (1)  _b[lagCredit_FE]*_b[  FC_LTV] = -_b[  laglfc_ltv]

           F(1, 120) =        0.74
            Prob > F =        0.3919

. . testnl (_b[lagCredit_FE]*_b[  FC_RWA]=-_b[  lagfc_rwa])

  (1)  _b[lagCredit_FE]*_b[  FC_RWA] = -_b[  lagfc_rwa]

           F(1, 120) =        0.11
            Prob > F =        0.7398

. . testnl (_b[lagCredit_FE]*_b[Deposit_FE]=-_b[lag_Deposit_FE])
(_b[lagCredit_FE]*_b[ IntRate_diff]=-_b[ lagintrate_diff])
(_b[lagCredit_FE]*_b[  Inf_vol]=-_b[ laginf_vol]) (_b[lagCredit_FE]*_b[
ERR_vol]=-_b[  lagerr_vol]) (_b[lagCredit_FE]*_b[  BSRI]=-_b[  lagbsri])
(_b[lagCredit_FE]*_b[ FO]=-_b[   lagfo]) (_b[lagCredit_FE]*_b[  FC_lim]=-_b[
lagfc_lim]) (_b[lagCredit_FE]*_b[   FCop_lim]=-_b[   lagfcop_lim])
(_b[lagCredit_FE]*_b[  FC_LTV]=-_b[  laglfc_ltv]) (_b[lagCredit_FE]*_b[
FC_RWA]=-_b[  lagfc_rwa])

  (1)  _b[lagCredit_FE]*_b[Deposit_FE] = -_b[lag_Deposit_FE]
  (2)  _b[lagCredit_FE]*_b[ IntRate_diff] = -_b[ lagintrate_diff]
  (3)  _b[lagCredit_FE]*_b[  Inf_vol] = -_b[ laginf_vol]
  (4)  _b[lagCredit_FE]*_b[  ERR_vol] = -_b[  lagerr_vol]
  (5)  _b[lagCredit_FE]*_b[  BSRI] = -_b[  lagbsri]
  (6)  _b[lagCredit_FE]*_b[ FO] = -_b[   lagfo]
  (7)  _b[lagCredit_FE]*_b[  FC_lim] = -_b[   lagfc_lim]
  (8)  _b[lagCredit_FE]*_b[   FCop_lim] = -_b[   lagfcop_lim]
  (9)  _b[lagCredit_FE]*_b[  FC_LTV] = -_b[  laglfc_ltv]
  (10) _b[lagCredit_FE]*_b[  FC_RWA] = -_b[  lagfc_rwa]

          F(10, 120) =        1.06
            Prob > F =        0.3949
```

Appendix 6.9 Estimated results of 6.9 RE with AR(1)

Model 6.10 estimated through RE AR(1)

```
. xtregar Credit_FE  Deposit_FE IntRate_diff Inf_vol ERR_vol BSRI FO  FC_lim
FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013, re lbi

RE GLS regression with AR(1) disturbances       Number of obs      =       174
Group variable: C_Id                            Number of groups   =        25

R-sq:  within  = 0.2330                         Obs per group: min =         6
       between = 0.8022                                        avg =       7.0
       overall = 0.6508                                        max =         7

                                                Wald chi2(17)      =    109.92
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0000

------------------- theta --------------------
  min      5%       median        95%      max
0.1677   0.1821     0.1821     0.1821   0.1821

------------------------------------------------------------------------------
   Credit_FE |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  Deposit_FE |    .404946   .1068642     3.79   0.000      .195496     .614396
IntRate_diff |   .0087628   .0031645     2.77   0.006     .0025606    .0149651
     Inf_vol |   .0008319   .0026075     0.32   0.750    -.0042786    .0059425
     ERR_vol |  -.6161537    1.59384    -0.39   0.699    -3.740023    2.507716
        BSRI |   .0001796   .0408268     0.00   0.996    -.0798394    .0801985
          FO |   .1898269    .077062     2.46   0.014     .0387881    .3408657
      FC_lim |  -.0322787   .0372821    -0.87   0.387    -.1053503    .0407928
    FCop_lim |    .164288   .0470834     3.49   0.000     .0720063    .2565696
      FC_LTV |   .1598601   .0424823     3.76   0.000     .0765963     .243124
      FC_RWA |   .0216037   .0308663     0.70   0.484    -.0388931    .0821005
      d_2008 |   .0124012   .0251975     0.49   0.623    -.0369849    .0617874
      d_2009 |  -.0219662   .0310983    -0.71   0.480    -.0829178    .0389854
      d_2010 |  -.0186625   .0339049    -0.55   0.582    -.0851149    .0477899
      d_2011 |   -.075364   .0379728    -1.98   0.047    -.1497893   -.0009388
      d_2012 |  -.0868967   .0389507    -2.23   0.026    -.1632387   -.0105547
      d_2013 |  -.0846335   .0399624    -2.12   0.034    -.1629583   -.0063087
       _cons |   .0666198    .134568     0.50   0.621    -.1971287    .3303683
-------------+----------------------------------------------------------------
      rho_ar |  .57013629   (estimated autocorrelation coefficient)
     sigma_u |  .05215975
     sigma_e |  .09904406
     rho_fov |  .21712375   (fraction of variance due to u_i)
------------------------------------------------------------------------------
modified Bhargava et al. Durbin-Watson = 1.0027084
Baltagi-Wu LBI = 1.3322592
```

Appendix 6.10 Complex correlation (model 6.1 estiamted excluding deposit euroization)

Model 6.1 estimated through system GMM, whilst treating all independent variables exogenous and excluding deposit euroization to check for a more complex type correlation

```
. xtabond2  Credit_FE   lagCredit_FE  IntRate_diff Inf_vol ERR_vol BSRI FO
FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013, gmm
(lagCredit_FE, collapse lag (2 3)) iv ( IntRate_diff Inf_vol ERR_vol BSRI FO
FC_lim FCop_lim FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013) small
two orthog robust
Favoring space over speed. To switch, type or click on mata: mata set matafavor
speed, perm.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: C_Id                            Number of obs      =       173
Time variable : Year                            Number of groups   =        25
Number of instruments = 19                      Obs per group: min =         6
F(16, 24)     =     72.00                                      avg =      6.92
Prob > F      =     0.000                                      max =         7
------------------------------------------------------------------------------
             |              Corrected
   Credit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lagCredit_FE |   .5483765   .1369174     4.01   0.001     .2657929    .8309601
IntRate_diff |   .0069024   .0033735     2.05   0.052    -.0000601    .0138649
     Inf_vol |   .0050023   .0043736     1.14   0.264    -.0040244    .0140289
     ERR_vol |  -.1197573   .6754203    -0.18   0.861    -1.513756    1.274242
        BSRI |  -.0095316   .0307403    -0.31   0.759    -.0729764    .0539132
          FO |    .097222   .0663623     1.47   0.156    -.0397429     .234187
      FC_lim |  -.0393604   .0196757    -2.00   0.057    -.0799689    .0012482
    FCop_lim |   .1510297   .0500125     3.02   0.006      .047809    .2542504
      FC_LTV |   .1064655   .0365889     2.91   0.008     .0309497    .1819813
      FC_RWA |   .0205559   .0221361     0.93   0.362    -.0251308    .0662426
      d_2008 |   -.008033    .048203    -0.17   0.869    -.1075192    .0914532
      d_2009 |  -.0306774   .0590073    -0.52   0.608    -.1524624    .0911076
      d_2010 |  -.0245761   .0474333    -0.52   0.609    -.1224737    .0733215
      d_2011 |  -.0769915   .0740832    -1.04   0.309    -.2298918    .0759087
      d_2012 |   -.068981   .0614269    -1.12   0.273    -.1957599    .0577979
      d_2013 |  -.0557119   .0635725    -0.88   0.390    -.1869192    .0754953
       _cons |   .0708539   .1349438     0.53   0.604    -.2076565    .3493643
------------------------------------------------------------------------------
Instruments for orthogonal deviations equation
  Standard
    FOD.(IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA
    d_2008 d_2009 d_2010 d_2011 d_2012 d_2013)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/3).lagCredit_FE collapsed
Instruments for levels equation
  Standard
    IntRate_diff Inf_vol ERR_vol BSRI FO FC_lim FCop_lim FC_LTV FC_RWA d_2008
    d_2009 d_2010 d_2011 d_2012 d_2013
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.lagCredit_FE collapsed
```

```
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -1.49  Pr > z =  0.137
Arellano-Bond test for AR(2) in first differences: z =  -1.07  Pr > z =  0.285
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(2)    =   0.24  Prob > chi2 =  0.889
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(2)    =   0.76  Prob > chi2 =  0.685
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(1)    =   0.39  Prob > chi2 =  0.532
    Difference (null H = exogenous): chi2(1)    =   0.37  Prob > chi2 =  0.544
```

Appendix 6.11 Additional test of complex correlation (model 6.1 estimated through OLS with deposit euroization o nthe left hand side)

A version of the Model 6.1 estimated through OLS, whilst having the deposit euroization as the dependent variable and all other independent variables of Model 6.1 in the right had side, to check for a more complex type correlation

```
. regress Deposit_FE Inf_vol ERR_vol IntRate_diff FO BSRI FC_lim FCop_lim
FC_LTV FC_RWA d_2008 d_2009 d_2010 d_2011 d_2012 d_2013

      Source |       SS       df       MS              Number of obs =     174
-------------+------------------------------           F( 15,   158) =   16.07
       Model |  4.31467887    15  .287645258           Prob > F      =  0.0000
    Residual |  2.82742697   158  .017895107           R-squared     =  0.6041
-------------+------------------------------           Adj R-squared =  0.5665
       Total |  7.14210584   173  .041283849           Root MSE      =  .13377

------------------------------------------------------------------------------
  Deposit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     Inf_vol |   .0094601   .0032232     2.94   0.004      .003094    .0158261
     ERR_vol |   1.098192   1.230963     0.89   0.374    -1.333073    3.529457
IntRate_diff |   .0043701   .0028869     1.51   0.132    -.0013318     .010072
          FO |   .1575378   .0464012     3.40   0.001     .0658912    .2491844
        BSRI |  -.1391254   .0267442    -5.20   0.000    -.1919476   -.0863032
      FC_lim |  -.0759015   .0287089    -2.64   0.009    -.1326042   -.0191987
    FCop_lim |   .2050263   .0275154     7.45   0.000     .1506809    .2593718
      FC_LTV |   .0449485   .0297305     1.51   0.133     -.013772    .1036691
      FC_RWA |   .0746187   .0242394     3.08   0.002     .0267438    .1224937
      d_2008 |   .0300788   .0387772     0.78   0.439    -.0465098    .1066675
      d_2009 |   .0670512   .0385653     1.74   0.084    -.0091188    .1432213
      d_2010 |   .0493185   .0387973     1.27   0.206    -.0273097    .1259467
      d_2011 |  -.0163268   .0403039    -0.41   0.686    -.0959308    .0632771
      d_2012 |  -.0016491    .040594    -0.04   0.968     -.081826    .0785278
      d_2013 |   .0104248    .041262     0.25   0.801    -.0710714     .091921
       _cons |   .5088489   .0891791     5.71   0.000      .332712    .6849857
------------------------------------------------------------------------------
```

```
. regress Deposit_FE Inf_vol ERR_vol IntRate_diff FO BSRI  d_2008 d_2009 d_2010
d_2011 d_2012 d_2013

      Source |       SS       df       MS              Number of obs =     174
-------------+------------------------------           F( 11,   162) =   10.48
       Model |  2.96854912    11  .269868102           Prob > F      =  0.0000
    Residual |  4.17355672   162  .025762696           R-squared     =  0.4156
-------------+------------------------------           Adj R-squared =  0.3760
       Total |  7.14210584   173  .041283849           Root MSE      =  .16051

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  Deposit_FE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     Inf_vol |   .0034842   .0036613     0.95   0.343    -.0037458    .0107143
     ERR_vol |   3.428245    1.41508     2.42   0.017     .6338646    6.222624
IntRate_diff |   .0076853   .0031419     2.45   0.016     .0014809    .0138898
          FO |   .2651213   .0536073     4.95   0.000     .1592621    .3709804
        BSRI |  -.2084869   .0278316    -7.49   0.000    -.2634464   -.1535275
      d_2008 |   .0050528   .0463466     0.11   0.913    -.0864686    .0965743
      d_2009 |   .0560064   .0461731     1.21   0.227    -.0351724    .1471853
      d_2010 |   .0440081   .0462618     0.95   0.343    -.0473459     .135362
      d_2011 |  -.0232084   .0465293    -0.50   0.619    -.1150906    .0686738
      d_2012 |   -.007542   .0466997    -0.16   0.872    -.0997607    .0846767
      d_2013 |   .0032683   .0471166     0.07   0.945    -.0897735    .0963101
       _cons |   .8286425    .085778     9.66   0.000     .6592553    .9980298
------------------------------------------------------------------------------
```